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Shaft-Sinking by Means of Large Drills.

THE accompanying engraving represents a drill used in sinking shafts of sufficient size to admit the passage of men, and the extraction of minerals and at the same time to afford sufficient room for pumps etc. The apparatus is the invention of Mr. HUGO SONTAG of St. Louis, who has had considerable experience in boring operations in Germany, and who came to this country recommended by men of high standing in German scientific circles.

MESSRS. KINDERMANN and KIND were the first engineers who drilled shafts as much as fifteen feet in diameter. Their operations in Westphalia and France, proved that a shaft could be sunk in this way for about what it would cost to construct a similar one by the ordinary methods, under favorable circumstances. The machinery employed by them was complicated, and could be used only by experienced and skillful men, and therefore their system has never come into general use. The sand-pump which they used to clean out the finely comminuted rock was especially objectionable.

The method pursued by Mr. SONTAG consists in sinking a smaller hole, say two feet in diameter, which he keeps from sixty to a hundred feet in advance of the main shaft, and into which the debris from the large hole is drained.

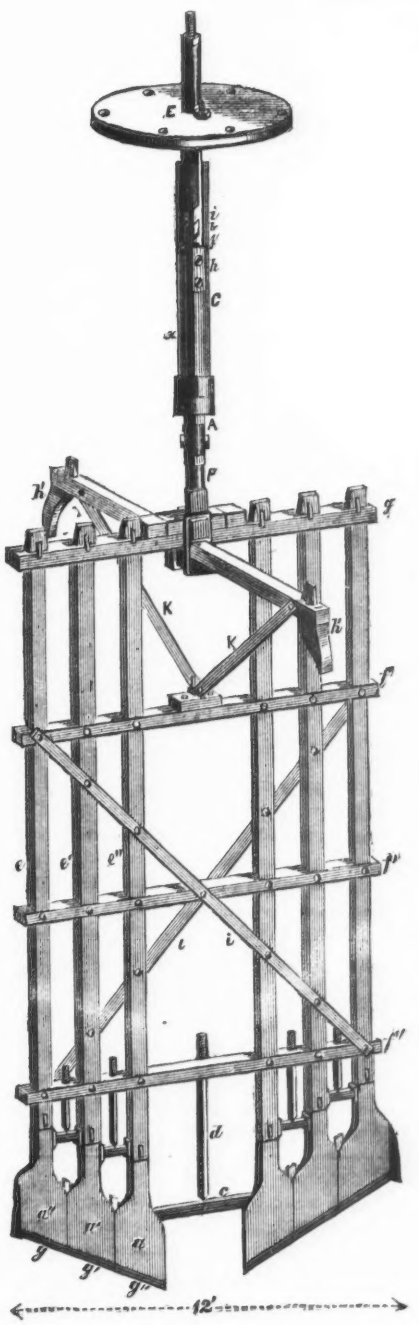
Near the top of the engraving will be noticed the dropping mechanism, which allows the free fall of the drill-frame and bits, which are used to drill the shaft. The drill-shank A connects this frame with a cylindrical rod, swiveled in the tubular shell C, and provided with projecting wings *b*, which rest on the enlargements *h* while the drill is being raised. The ears *i* and *j*, which are connected with the valve E by small rods, throw the wings *b* off from the enlargements *h*, when valve E receives an upward thrust from the resistance of the water as the apparatus is lowered. The valve is merely a disk which fits loosely in the drilled hole. Above the dropping mechanism, iron rods screwed together run to the surface, and are there put in connection with a steam engine by which the apparatus is alternately raised and lowered, so as to cause the dropping mechanism to operate and allow the bits to strike a sharp blow on the rock.

On the up-stroke, the ears *i*, operated by the valve E push down the wings b, and hold them on the enlargements *h*; on the down-stroke the lower ears *j* push up the wings, and allow them to drop down in the slots of the shell. The height of the fall which the frame and bits thus receive is twenty-one inches.

The construction of the drill frame will be sufficently clear from the engraving, when we say that it is made entirely of iron, the upright rods, *e*, being five inches square, and not more than fifteen feet long, secured by horizontal bars, *g*, *f*, *f*¹.

The bits, connected with the rods, *e*, have their cutting edges inclined about 30° to the horizontal, the slope being towards the centre of the shaft. By means of this arrangement the sand formed by the drill quickly finds its way into the smaller hole, already alluded to, from which it can eadily be removed in a receiver or sand-pump.

In order to prevent the breaking or bending of the bits from the side blow of the inclined edges, the struts, *c*, are added. These are held down by the screws, *d*. The keys, *v*, also serve to prevent the bits from being forced inwards. The cross-bar, with



SHAFT-SINKING BY MEANS OF LARGE DRILLS

the small bits, *h*, guides the apparatus, and perfects the walls of the shaft.

It will be seen that the strong construction of the drill frame gives considerable weight to the apparatus, and causes the bits to strike a powerful blow on the rock at each fall, while the sloping of the bottom and the drainage into the smaller hole, always keep a clean rock surface for them to strike against, so that the blow is extraordinarily effective. The inventor claims that it is at least twice effective as when the bottom of the hole is not clean. Mr. SONTAG employs KIND'S *cuvelage*, or tubbing, without any modifications. It is so well adapted to the purpose for which it is used that improvements seem impossible.

To bore a shaft in this way, two engines are required; the one a single acting, and the other a hoisting engine. A foreman, an engineer, a fireman, a blacksmith, and four workmen, are the force required to carry out the work.

Extract of the Report on the Boilers Exhibited at the Recent Fair of the American Institute.

THE undersigned, the Committee appointed by you as Judges in Department V, Group I, beg leave to report as follows in reference to the Steam Boilers entered in competition at the Industrial Exhibition of the Institute, just closed:

The boilers thus entered were five in number. Taken in the order in which we tested them, they were the Root, the Allen, the Phleger, the Lowe, and the Blanchard boilers.

The Committee propose to compare these boilers, and to state what they consider their relative values in the following points, viz.: 1st, safety; 2d, durability; 3d, economy in fuel; 4th, capacity for making steam. These four points are believed to cover all essential considerations in selecting a good steam boiler, with the single exception of first cost, which can be more satisfactorily investigated by the purchaser than by your Committee.

* * * * * * *

Your Committee consider that the competing boilers should be placed in the following order, as respects safety, and they accord them marks on a scale of 10, *ten* representing a perfectly safe boiler, and *zero* a worthless one:

Root	Allen	Phleger	Blanchard	Lowe
9	8½	7	6	5½

Second, Durability. On this point, as well as the preceding, the Committee can state only their opinion. To make a perfectly reliable determination by actual experiment and observation is, of course, beyond their power. In their judgment, however, these boilers would, if thoroughly tested, be found to stand in the following order, and to be deserving of the following marks for durability:

Root	Allen	Phleger	Lowe	Blanchard
9	8½	6	5½	5

Third, Economy of fuel.

Fourth. Capacity for making steam.

On these two points your Committee felt it their duty to make a careful report, based upon a thoughtfully devised and critically accurate series of experiments.

[The report proceeds to give the details of the elaborate series of experiments instituted to test the several boilers, and tables of the results, which will be published in full by the American Institute. We

select and condense the following results of the experiments :]

The quantity of heat per pound of fuel, in thermal units, being a measure of the relative economic efficiency, was as follows :

Root,	10,281.53
Allen,	10,246.92
Phleger,	10,269,71
Lowe,	10,048.24
Blanchard,	11,676.47

Determining the weight, in pounds, of water evaporated per square foot of heating surface per hour, we get as a measure of the steaming capacity :

Root,	2.65
Allen,	3.59
Phleger,	2.83
Lowe,	3.10
Blanchard,	1.92

It is but right to remark here that, as is indicated by the log, by a miscalculation, the fires in the Root boiler were allowed, at one time, to get much too low, and it is supposed that the standing of that boiler was thus seriously impaired. The fires of the Lowe boilers were undisturbed during the whole trial, its position also being thus slightly lowered.

The quantity of heat per pound of combustible, as above determined, being divided by the latent heat of steam at 212 degrees Fahr. (966·6) gives us the equivalent evaporation of water at the pressure of the atmosphere and with the feed at a temperature of 212 deg. Fahr. :

Root,	10.64 pounds.
Allen,	10.60 "
Phleger,	10.62 "
Lowe,	10.396 "
Blanchard,	12.08 "

For general purposes this is the most useful method of comparison for economy.

The amount of water, in pounds, actually evaporated per pound of combustible, was as follows :

Root,	8.76 pounds.
Allen,	8.76 "
Phleger,	8.84 "
Lowe,	8.55 "
Blanchard,	9.69 "

Comparing the above results, the Committee are enabled to state the following order of capacity and of economy in the boilers exhibited, and their relative percentage of useful effect, as compared with the economical value of a steam boiler that should utilize all of the heat contained in the fuel.

	Steaming Capacity.	Economy of Fuel.	Percentage of Economical Effect.
Root	No. 4	No. 2	0.779
Allen	No. 1	No. 4	0.776
Phleger	No. 3	No. 3	0.778
Lowe	No. 2	No. 5	0.762
Blanchard	No. 5	No. 1	0.885

CONCLUSIONS.

The Committee would finally remark :

1st. That the results of this trial indicate that, in steam boilers as now built by the best manufacturers, the differences in most respects are exceedingly small, and a purchaser can hardly fail to be well served if he goes to a really intelligent and reliable builder.

2d. That the introduction of boilers having exceptionally large proportion of heating surface, and with large feed water heaters, and depending upon a mechanical draft, will, when properly designed and constructed, be attended with a marked economy, which, the Committee judge, should more than compensate for the increased trouble and expense involved by them.

3d. That the steaming capacity of a boiler depends largely upon its form, as well as upon the method of working its fires.

4th. That they are very greatly pleased with the result of this first trial of the method adopted of determining the economical performance of steam boilers, and their capacity for making steam. They earnestly desire to impress upon the Board of Managers the importance to the country and to manufacturers of boilers, of having a standard set of apparatus, such as your committee have used, constantly available for such trials of steam boilers.

They would also urge a consideration of the advantage to the American Institute of such tests as are above described, which, being publicly conducted, with the best apparatus available, and with all of the accuracy and reliability which by this method is easily attainable, place the decisions of the Judges and the awards of the Board of Managers beyond dispute.

With the experience now obtained, the results of such tests can be readily worked up, although none but those who have gone through with the work, can appreciate the labor involved in such a series of calculations.

They would earnestly recommend to the Board of Managers that provision be made for the erection of a well built condenser, with meters carefully and specially constructed for the work, and with thermometers of the greatest possible accuracy and delicacy ; every possible provision being made for obtaining the most reliable results, and steam boiler trials by this apparatus, when completed, be made one of the regular features of the Annual Exhibition of the Institute.

The members of the Committee will gladly give all needful instructions for the building of such an apparatus, and have no doubts that a moderate charge being made for the privilege of its use by unfortunate competitors of former occasions, and by builders of new forms of boilers, a reasonable profit might be made to accrue to the Institute from such an investment. Even were there no direct income from it, the advantages in other respects to the Institute, and to its friends and the people generally, would be far more than commensurate with the moderate expense involved. Very respectfully,

ROBERT H. THURSTON.
THOS. J. SLOAN.
ROBERT WEIR.

January, 1872.

After the reading of the above report,

Dr. VAN DER WEYDE said : One great point has been brought out by this report, that the BLANCHARD boiler, which has the largest amount of evaporating surface, was the most economical.

Mr. FISHER—Could you tell, in these experiments, how much heat went up the chimney?

Professor THURSTON—We know the temperature of the gas that went up the chimney, but not the quantity.

Mr. FISHER—The evaporation per foot of surface seems to have been quite small.

Professor THURSTON—It is the evaporation with a natural draft, with low chimnies. In the locomotive you have a forced draft, and in the Cornish boiler you have high chimnies, so that their evaporation will be greater.

Mr. FISHER—It appears to me that these boilers did not perform so efficiently as locomotive boilers.

Professor THURSTON—You cannot judge of the evaporation of a boiler that has not been tested in this way, A gentleman told me that on testing his boiler he found that it evaporated 18 lbs. of water to the pound of coal. I told him that was 20 per cent. more than a perfect boiler would evaporate ; so that it was evident that a large amount of water had passed off with the steam. He said that he had held his handkerchief in the steam and it came out dry. He went back and made another trial, and made it 15 lbs. ; but on trying the thermometer he found that it indicated a higher temperature than that due to the pressure. Another experiment brought down the apparent evaporation to 12 lbs. and a fraction. I have no doubt that in his first experiment he had made the performance at least double what it really was.

Dr. VAN DER WEYDE repeated his suggestion, given in his lecture on heat, that an excellent test is to blow steam into water until we have added a pound to the weight of the water. This requires no apparatus, and enables us to determine from the rise of the temperature of the water, how much water was discharged mingled with the steam.

Professor THURSTON—That would be a very accurate and convenient method for ordinary purposes.

Mr. PARTRIDGE—A further application of this method has been made use of by several engineers in this city, in testing steam pumps. Thermometers are placed in the water that enters the pump, and in the water as it passes away. The radiation is very little, and the results compare favorably with those taken by more expensive methods.

Mr. GEDDES—Would the tests made by this Committee enable them to advise the Board of Managers as to the form of boilers to be purchased for the Fair? Whether it should be one of the forms reported upon or some other form of boiler ?

Professor THURSTON—All our examinations have been with regard to these five boilers ; but we consider them as very good specimens of boilers.

On the motion of Mr. BLANCHARD, a vote of thanks for the report read by Professor THURSTON, was passed.

Adjourned.

Geological Notes on Part of Utah.

By Prof. B. SILLIMAN. *

WITHIN the last two or three years, important developments have been made in the mineralogy and metallurgical resources of the eastern ranges of the North American Cordilleras of the Great Basin, and especially in the Wahsatch and Oquirrh Mountains of Utah, in the valley between which flows the Jordan river, pouring the fresh waters of Utah Lake into the Great Salt Lake. It is in these two ranges of mountains that the most important and best known of the "mining districts" of Utah Territory have been established.

Commencing on the western slopes of the Wahsatch, near Salt Lake City, we find in order, going southward, the districts known as "New Eldorado," "Big Cottonwood," "Little Cottonwood," and "American Fork ;" on the eastern flanks of the same range are the "Uintah" and "Snake Creek" districts, while on the southern extension of the Wahsatch are the "Spanish Fork," "Mount Nebo" and "Tintic" districts.

On the Oquirrh range, looking to the east, are "the West Mountain" and "Lower Districts"—"Bingham Cañon" being the most important locality of the first-named district. On the western side of the Oquirrh range, looking, in part, over Rush Valley, are the "Tooele," the "Stockton," the "Ophir," the "Camp Floyd" and the "Osceola" district : "East Cañon" in the Ophir district being one of the most important of the new mining regions.

There are other mining districts in the lower extension of the above ranges, and also in other ranges of Utah, but we need not dwell on them at present. †

The characteristic metallurgical features of all the mining districts of the Wahsatch and Oquirrh is the occurrence of ores of lead, rich in silver. The two ranges mentioned fall within the zone of argentiferous galena lodes which extend through New Mexico, Utah and Western Montana.

The writer had occasion, in 1864, while studying the structure of the parallel ranges of Nevada, to

* This article is published, through the courtesy of the author, from advanced sheets of the *American Journal of Science and Arts* for March. The remainder of the article, which our columns have forced us to divide, is given in our Mining Summary, under the head of "Utah Ores."

† Two hundred miles farther south, and chiefly in the counties of Beaver and Piute, upon the so-called "Beaver River range" and "Mineral range," are Washington, Star, Lincoln, Granite and Beaver districts in Beaver county, and the Ohio and Warsaw districts in Piute county ; some of these are probably important, but are as yet only imperfectly explored districts, yielding copper, iron. gold, silver, antimony, bismuth, &c,

note the fact that these ranges were characterized by the existence in each of parallel zones of metallic value ; sometimes of the precious metals, almost without admixture of base metals, as in the Plutonic rocks of Western Nevada, full of evidence of hot springs, solfatara and volcanic action, and yielding such mines as those of the Comstock lode and of Aurora, Bodie, and the White Mountains ; or again, those like the Toyabe range, yielding silver with base metals, as antimony, lead, arsenic, copper, zinc, &c., as is also true in a more marked degree of the Humboldt range. So, in the present case, we find in the Wahsatch and Oquirrh ranges ores of silver, either argentiferous or galenite, or largely epigene species secondary to galenite, with some ores of copper, antimony, zinc, &c., from which silver is rarely entirely absent. Prof. W. P. BLAKE, in his catalogue of Californian minerals sent to the Paris Exposition (1867), distinctly points out this parallelism in the metallic contents of the ranges of the American Cordilleras, and the same feature is fully recognized by Mr. KING in his chapter on Mining Districts introductory to "Mining Industry," vol. iii of the Geological Exploration of the Fortieth Parallel, p. 5.

The structure of the Wahsatch and Oquirrh ranges are fortunately exposed to view by the cañons, which cut profoundly from them into the valleys. It is in these canñons that most of the mining districts are located, and through them the summits of the ranges are conveniently reached.

The Big Cottonwood and Little Cottonwood cañons, for example, expose profound sections of the Wahsatch range, cutting eastwardly across the structure of these mountains, forming a V-shaped chasm with very precipitous sides and obliquely transverse to the axis of the main range. Thus the average direction of the Little Cottonwood cañon is N. about 62° East, cutting the main range at an angle of about 30°. Entering this cañon, above the mesa over the Jordan valley (Salt Lake Valley), the observer finds himself at once within very precipitous cliffs of gr y granite, and surrounded with massive fallen blocks of the same rock of remarkable uniformity of texture and with broad cleavages. The bedded structure of this granite is conspicuous, the beds dipping easterly into the mountain at a high angle, recalling the fan-like structure of the western slopes of the Sierra Nevada as seen in California. This rock extends up the cañon for several miles, the lines of original bedding being distinctly visible. These granites are probably metamorphic of conglomerates, an opinion first suggested to me by Prof. W. P. BLAKE. Besides the conspicuous patches of darker colored material pasted into the light gray matrix, with the aid of a glass one can detect a certain pebble-like roundness in the quartz of this granite, and an absence of crystalline structure suggestive of a mechanical origin. It is in the lower part of this cañon that the granite has been quarried for building the Mormon Temple at Salt Lake City. These quarrying operations have been confined to splitting the great fallen masses of granite on the surface, and we may here see fresh faces thus split, measuring, at least, twenty feet vertical by more than these dimensions laterally.

At a cabin known as "Garrard's house," some six or eight miles up this cañon, is a fine terminal moraine of the ancient glacier system, forming a complete dam across the cañon, over which the road now winds, and through which the mountain torrent finds its way after giving motion to Garrard's mill. The surface of this old moraine I found to be approximately 2,140 feet above the Townsend House in Salt Lake City. The Townsend House is about 60 feet above Great Salt Lake, so that the lower end of the ancient glacier system of the Wahsatch at this point was, in round numbers, 2,200 feet above the present level of Salt Lake, or 6,4000 feet above sea level, assuming 4,200 feet to be the proper elevation of this inland sea, as commonly stated.

The following heights were determined by one of Green's aneroid barometers, and may be considered as approximate.

	Above Salt Lake.
Townsend House, in Salt Lake City,	60 feet.
Mesa, over Salt Lake Valley.....	510 "
Emmaville, half-way house.....	655 "
Garrard's House, top of old Moraine,	2200 "
Central City, 6 miles above Garrard's,	4460 "
Emma Silver Mine	5560 "

The loftiest point yet measured in the Wahsatch is the Twin Peaks, which CLARENCE KING has determined. I have not seen his figures, but they are said to make this point over 12,000 feet above tide.

The granite in the Little Cottonwood cañon is followed by heavy-bedded quartzites, and these are succeeded by slates, upon which rest conformably thick beds of crystalline white limestones. Obscure forms, probably organic, are occasionally seen on the weathered faces of the white limestones, but all I was able to collect of these are so much altered by the metamorphism of the matrix and by exposure as to be mostly unintelligible. A well-characterized *Archimedes*, in the possession of Prof. BLAKE, renders it highly probable that the limestones are, in part, at least, carboniferous, though the geological position of the beds indicate for a large part of the mass a lower horizon. I find by chemical analysis that the white limestones, containing the obscure fossils, are not magnesian. They contain a little silica, with minute scales of white mica, and a little combined alumina and sesquioxide of iron. But the limestones in which the silver ores are found are saccharoidal, and without crystalline structure. They are, moreover, dolomite in chemical constitution, almost completely free from silica and iron. but containing a little alumina. This latter rock breaks up into small rhombic masses, and is easily reduced to a fine granular non-crystalline powder, while the non-magnesian beds beneath resemble dolomite in fracture, though quite free from magnesia. They are non-fossiliferous, so far as observed by me. Whether they are strictly conformable to the crystalline white limestone is doubtful, and further explorations are needful to decide this point, which is one of considerable interest in view of their mettallurgical contents.

The Polytechnic Association of the American Institute.

Meeting held Jan. 12th, 1872. President TILLMAN in h r.

STEAM BOILER EXPLOSIONS.

MR. BLANCHARD—I was very much gratified by the report of the experiments on boilers, which we have had before us, from the fact that it places the ordinary common-sense view of the subject in a favorable light ; for the boilers were shown to burst from over-pressure. One boiler yielded suddenly and at once in a great many places, very much like Dr. HOLMES' "one-horse chaise," which was so equally strong in every part that it all went to dust at once. (Laughter.) This boiler was so well constructed that when the pressure rose to a sufficient point, the joints began to leak in a great many places, and it could not be much of an explosion.

There was one remark made in connection with the report, which I think ought not to have been made ; that a boiler may stand a certain hydraulic pressure. and afterwards, when exposed to steam pressure, burst at less than the hydraulic pressure. You might as well say that after filling a jug with two quarts of water, you might afterwards find that it would hold but three pints.

The PRESIDENT—Might not the heat help to burst the boiler?

Mr. BLANCHARD — The heat would reduce the strength a little.

Mr. STETSON—It has been asserted that heat increases the strength of iron up to 500° Fahr.

Dr. PARMELEE—On a question like this, we want practical facts. JOHN MATTHEWS, the soda fountain man, told me but a few weeks ago, that some years ago he had the brilliant idea of making steel receivers to hold carbonic acid ; for steel would be light, and give a great amount of strength. He brazed them, and subjected them to 150 lbs. pressure. His father suggested to him to keep up the pressure for a while, for they might burst. They were allowed to stand, and the pressure gradually diminished until ultimately it came down to about half that pressure, when the receiver exploded with great violence. Why was this? The theory is this : There is no alloy of two metals, the atoms of which have the same adhesion that the original metals have. The atoms tend to roll around each other, as the glaciers do. When the hydrostatic pressure is first applied, it does not move them at first, because they require time to move. You may put millions of tons upon a glacier without moving it, and yet, it is constantly progressing. In the boiler, you apply the pressure and see no result. You afterwards apply a lower pressure, continuously, and the atoms continue to move, the joints becoming gradually weaker, until at last the weakest point gives way, and you have an explosion, although the hydrostatic pressure has never been reached since the original test.

Among the causes of boiler explosions, I have met with one in my own practical experience, which I have never heard mentioned among all the theories advanced ; for I had a boiler, which was accidentally left in the winter, filled with water, and its freezing burst the boiler. (Laughter.)

Mr. BLANCHARD — I do not deny that chemical causes may weaken a boiler, after the hydrostatic test ; but I object to the glamour of the supernatural, in the theory that a boiler which will stand a certain test to-day, will to-morrow, without any change, explode at a materially lower pressure.

Prof. THURSTON—Very fortunately I received to-night the proof-sheets of an article I prepared for the Journal of the Franklin Institute, upon this subject, and I will read a portion of it :

"*Third*, That a steam boiler may explode, under steam, at a pressure less than that which it had successfully withstood at the hydrostatic test.

"The last boiler had been tested to 59 lbs., and afterwards exploded at 53½ lbs. This fact, too, although frequently urged by some engineers, was generally disbelieved. It has now been directly proven."

In a foot-note, I say :

"A number of instances of this kind, though not always producing an explosion, have been made known to the writer.

"Two boilers at the Detroit Water Works, in 1859, after resisting the hydrostatic test of 200 lbs., with water at a temperature of 100° Fahr., broke several braces each at 110 and 115 lbs. steam pressure respectively, when first tried under steam.

"The boiler of the United States steamer Algonquin was tested with 150 lbs. cold water pressure, and broke a brace at 100 lbs. when tried with steam.

"A similar case occurred in New York, a few years ago, and the boiler exploded with fatal results.

"These accidents are probably caused by changes of form of the boiler, under varying temperature, which throw undue strain upon some one part, which may have already been nearly fractured."

In the same article, I said :

More than thirty-five years ago, a committee of the Franklin Institute made a series of experiments of such extent and accuracy that the republication of their reports, and their circulation among engineers, would to-day be a public benefaction.* Their reports, together with the paper of F. A. PAGET, on the "Wear and Tear of Steam Boilers," † and the little book of E. B. MARTIN ‡ on explosions, should be in the library of every engineer.

The experiments of the committee of the Franklin Institute were made upon a small scale, and upon

* *Vide* Journal Franklin Institute, 1836, Vol. XVII.

† Ibid., 1865, Vol. I.

‡ Records of Steam Boiler Explosions ; E. B. MARTIN : London : E. & F. N. SPON, 1871.

constructions quite different in form from most steam boilers, and, although the information obtained was invaluable, it still remained desirable to repeat their experiments, and to make other investigations with boilers of full size, such as are used in steamers, on our railroads, and in our manufactories.

After describing the experiments, I continued:

Having briefly described these experiments, it may be well to notice what bearings their results have upon existing beliefs, and how far they extend our knowledge of the causes and conditions of explosions.

In the first experiment, we probably have an illustration of by far the most usual behavior of steam boilers, when yielding to over-pressure. The pressure gradually rising, ruptured the boiler at its weakest point, which happened to be a spot of merely *local* weakness; the rent extended towards stronger portions, but soon became large enough to discharge the steam as rapidly as it was made. The strength of the metal in the direction of the line of fracture being sufficient to resist further extension at the maximum pressure attained, no greater injury was done. The spot being patched, the boiler is still probably capable of doing good service for a considerable length of time.

When boilers give way from excessive weakness or from steam pressure, they very generally do so in the manner described. The explosion is the exceptional case, and the frequency with which old boilers "blow out" in every part, though usually about the stayed surfaces, and the apparent impunity with which they are kept at work after being frequently patched, has probably been the most influential cause of the existence of the belief, which is, unfortunately, widespread among engineers, that the mere pressure of steam cannot cause explosions, and that, if the boiler contains a sufficient quantity of water, it is perfectly safe, except against sundry mysterious forces, which are probably, like the fairies and ghouls of earlier times, existent only in the imaginations of those whom they terrify.

In the second and third experiments, we have illustrations of the comparatively rare cases in which explosions actually occur.

The second was a perfectly new construction, in which corrosion had not developed a point of great comparative weakness, and the fracture occurring simultaneously, and very equally on all sides, the two halves were completely separated. and thrown far apart with all the energy of unmistakable explosion, although there was an ample supply of water, and the pressure did not exceed that frequently reached in locomotives and on the western rivers, and although the boiler itself was quite diminutive.

The unexpected circumstance of the drawing out of the stay-bolts without breaking and without stripping their threads, was one of the most interesting points of the experiment.

In the third experiment, as in the second, it is probable that the weakest part extended very uniformly over a large part of the boiler, either in lines of weakened metal, or over surfaces largely acted upon by corrosion. Immediately upon the giving way of its braces, fracture took place at once in many different parts.

We may conclude, then, from the result of Mr. STEVENS' experiments:

First, That "low water," although undoubtedly one cause, is not the only cause of violent explosions, as is so commonly supposed, but that a most violent explosion may occur with a boiler well supplied with water.

This was shown on a small scale by the experiments of the committee of the Franklin Institute above referred to.

Second, That what is generally considered a moderate steam pressure may produce the very violent explosion of a weak boiler, containing a large body of water, and having all its flues well covered.

This has never before, we believe, been directly proven by experiment.

The third result I have already read.

Professor T. proceeded to give a calculation roughly made of the force manifested in the explosion of one of the boilers, compared with the pressure of the steam; and continued:

Mr. STEVENS suggested that as this large boiler had been under steam for a week at low pressure, there might, perhaps, be a portion of that heat stored up, which was developed in the explosion; but this calculation, which I intend to repeat with more accuracy hereafter, shows that the work done in the explosion was not assisted by any such superfluous heat.

Dr. RICHARDS—How do you explain the bursting of a boiler at a pressure less than the hydrostatic test?

Professor THURSTON—I have very little doubt that the reason was that the strain was thrown differently upon the braces, when heated to the temperature of 300 degrees than when it was cold. I have no doubt that Mr. Wiard is correct in attributing many explosions to unequal expansion; but I would no sooner ascribe all explosions to that cause than give one medicine for all diseases. I think we know the causes of all explosions, and that with proper care and intelligence on the part of those who design, those who construct and those who manage boilers, explosions can be avoided, except in those exceedingly rare cases in which accidents occur, notwithstanding the most careful management.

Mr. J. R. FISHER suggested the bursting of a boiler by forcing air into it, so that the rupture might take place at the temperature of construction.

Professor THURSTON—It is proposed to explode one boiler by the pressure of the steam in another boiler; also, to observe the effect of raising the safety valve suddenly, and to pursue the experiments upon various points just as far as the funds contributed will enable the experiments to be made.

Adjourned.

Meeting held February 2nd, 1872, President TILLMAN in the chair.

ROAD STEAMERS.

Mr. J. R. FISHER read a paper describing the various carriages proposed for the use of steam upon common roads.

Dr. VAN DER WEYDE—I saw in Paterson 16 horses driven by half a dozen men with whips, drawing a large locomotive up quite a steep hill, and I saw one of these little steam carriages attached to another locomotive of equal size, and drawing it up the same hill, apparently with great ease. The contrast was very striking.

Mr. BLANCHARD—We are gradually perfecting the arts which tend to the perfection of steam carriages, and, perhaps, it will not be long before we shall arrive at the point when they can be made profitably for common roads; but of that I have some doubt, for it seems to me that the power necessary to run a steam carriage over a soft surface like a meadow is too great for economy. It will certainly be a losing operation for the first undertakers of the project. My idea of a steam carriage would be to make the boiler only three or four inches deep, and to heat it with kerosene lamps fitted into slides to run under the boiler. I believe that kerosene will give more power for a given weight than coal. I would have a water tank to prevent the heat from reaching the carriage above, and under the boiler I would have two small engines operating the opposite sides of a crank.

Professor PHIN—The horse is the worst animal in the world to go over soft ground, because his hoofs cannot expand; but you can make the wheels of the locomotive as broad as you please.

Professor WHITNEY—I have seen the two leading traction engines in operation—that of Thompson, and that of Aveling & Porter. That of Thompson had a horizontal boiler and india rubber tires. Both that and the engine of Aveling & Porter work extremely well. I have seen them plough, with seven ploughs, a foot furrow, and do it well, and if they could rely upon a uniform consistency of the ground underneath, they would be very useful. But in this experiment one of them came to an ant hill, and there it stopped and took nearly half an hour to get it out. They will travel across soft ploughed ground without the slightest difficulty, and on a hard road will draw heavy wagons or pass up a steep bank. There is very little to choose between the two, excepting to adapt them to special conditions and circumstances. Some of them have been sent to California and some to Utah. I do not think they will work well in either of those countries, because all through California and Utah you will find the hole of the gopher and prairie dog, and no traction engine could plough across those fields. In order to be used there the roads must be made good, and upon a good hard road they may be successful.

Dr. RICHARDS—Mr. Baxter, the inventor of a boiler, has formed a company to manufacture engines and cars for common street railroads. His boilers are the safest, I think, that I have ever examined.

Mr. FISHER—I omitted to state that the boilers I have represented are intended to be so safe that they may be burst purposely without doing any harm.

ARTIFICIAL MUSK AND ORGANIC COMPOUNDS.

Dr. VAN DER WEYDE—I have first to present for your examination a specimen of artificial musk, which is made of blood, treated in a peculiar manner. At first it could be distinguished from the genuine musk from the absence of the little hairs which musk always contains; but the inventor takes some of the hair and puts it in his artificial musk, and now even the microscope cannot distinguish between the two.

Chemists have frequently transformed one organic substance into another organic substance. Professor Schultz, of Germany, has succeeded in making mellithic acid, which may be changed into benzole, and then we can make the whole series of anilines and all the aniline colors, producing all these substances in the laboratory without the assistance of any organic compound. Whether it will be of any advantage is a question to be decided by experience. It is enough for the present to know how it can be done. Oxalic acid and acetic acid have both been before made artificially. Alcohol has been made artificially from common coal gas. Dextrine also has been made artificially.

The PRESIDENT—It will be remembered that I read an article on mellithic acid a few weeks ago.

STEAM BOILERS.

Professor R. H. THURSTON read the report of the judges on steam boilers at the last fair of the American Institute, an extract of which will be found elsewhere.

Temperature of Explosions.

ACCORDING to recent experiments in France, the fulminate of mercury becomes ignited and detonates at 200 degs.; gun-cotton, at 220 degs.; gunpowder used for heavy ordinance, at 295 degs.; the picrates of lead, iron, and mercury, all at 296 degs.; nitroglycerine, at from 256 to 257 degs.; sulphur ignites in air at 246 degs.; the powder (fulminate) contained in the caps of the Chassepot rifles, at 191 degs.

THE *Coal and Iron Record* is the name of a new weekly, "devoted to the coal and iron trades," edited by Mr. B. R. WESTERN. It would be scarcely fair to point out the deficiencies of a first number, since, no matter how much delay and care are involved in its production, there must always be many things going wrong, and requiring time for adjustment.

Removal of Office.

AFTER May 1st the office of the ENGINEERING AND MINING JOURNAL will be found at No. 27 Park Place, corner of Church street. The offices of the *Christian Union*, and of one or two other paper, are already in the same building, the location of which is more convenient for us than the one we have so long occupied.

THE COAL TRADE.

NEW YORK, February 16, 1872.

Anthracite Coals.

WHOLESALE.—The demand for coal continues very moderate and the prices are unchanged, except those of the Delaware and Hudson Canal Company, which are reduced from twenty-five to forty cents per ton from our last quotations.

Some dealers seem to be more hopeful for a profitable business when navigation opens, than they were immediately after the Scranton sale. The demand for shipment to eastern ports will doubtless improve, and as the supply will probably continue at about the present figures, there seems but little reason to consider these gentlemen over sanguine. Even to the ports which are not closed with ice, the high rates of freight have seriously interfered with the shipment of coal. To Boston, for example, it has been impossible for weeks past to ship coal for less than three dollars, which is, we should say, about a dollar and a quarter above the usual rates; so Boston dealers and manufacturers can afford to take the chances of coal being higher when freights come down, which they are sure to do in the spring. Whether their money goes into the pocket of the coal operator or that of the transporter, makes but little difference to dealers. The probability is that freights will decline before, or in a greater ratio than coal advances. No one expects high prices to rule during the coming season, but operators and dealers hope for prices at which they can sell large quantities of coal and live.

It will be seen by reference to our tables that the shipments from the various regions exceed those of last week by about thirty thousand tons.

RETAIL.—The large companies continue to sell coal at retail at about the rates that we have quoted from time to time, viz., $4 75 for egg; $5 25 for stove; and $4 25 for chestnut.

FREIGHT.—Our quotations will be found somewhat lower than last week, but the change is not very material except to certain points. Vessels continue very scarce, and small vessels are very stiff in their prices.

Bituminous Coals.

The prices of these coals are unchanged, and this is a fact which well deserves attention when we see how low the anthracite market runs. The only explanation of it seems to be that during the strike last year steamboat companies and others were compelled to use this kind of coal, and since that time they have preferred to pay present prices for it to going back to anthracite. Actions, in this matter, as in most others, speak much louder than words.

Anthracite Coal Trade for 1871 and 1872.

The following table exhibits the quantity of Anthracite Coa passing over the following routes of transportation for the week ending Feb. 10, 1872, compared with the week ending Feb. 11, 1871.

COMPANIES.	1871. WEEK.	1871. TOTAL.	1872. WEEK.	1872. TOTAL.
*Phila & Reading R.R†	13,115	540,576	45,286	519,855
Schuylkill Canal	....	....	....	....
*Lehigh Valley R. R.	1,550	335,116	45,608	513,985
Lehigh & Sus. R. R.	868	55,923	11,654	133,314
Lehigh Canal	....	....	....	....
Scranton North	....	3,523	10,874	72,729
" South	....	137	34,219	225,149
Penn. Coal Co., rail	69	2,761	15,403	105,070
" " " canal	....	....	....	....
Del. & Hud. Canal Co.	....	....	....	....
" East	2,502	48,332	7,479	62,588
" West	134	12,721	7,010	41,360
" South	....	....	6,041	41,280
Shamokin	3,967	33,158	7,531	30,806
Trevorton	....	....	....	....
Lykens Valley Coal Co.	1,845	9,732	....	62
Wyoming South	....	....	....	....
Wyoming North	....	....	....	....
P. N. Y. C. & R. R. Co.	....	32,182	....	....
Williamstown Col'y.	....	17,847	....	....
Big Lick Col	2,281	11,161	881	4,256
Total	26,331	1,103,166	191,986	1,741,455
1870	....	....	26,331	1,103,166
Decrease				
Increase			165,655	638,289

* These figures are for the week and fiscal period commencing Nov. 30.

† Less coal transported for Co's use and Bituminous coal.

Huntington and Broad Top R. R. Co.

For week ending Feb. 10, 1872	4,461 tons.
Same time last year	4,514 "
Increase	"
Decrease	54
Total amount shipped to date	31,561 "
Same time last year	24,640 "
Increase	6,921 "
Decrease	

Bituminous Coal Trade, 1871 and 1872.

The following table exhibits the quantity of Bituminous Coal passing over the following routes of Transportation for the week ending Feb. 10, 1872, compared with week ending Feb. 11, 1871.

COMPANIES.	1871. Week.	1871. Year.	1872. Week.	1872. Year.
C. & O. Canal	....	.....	....	.....
B. & O. R. R.	9,000	63,377	17 547	103,164
H. & B. T. R. R.	4,514	24,640	4,461	31.561
*Harrisburg & D.	6,379	44,816	4,599	104,779
*L. V. R. R.	....	2,639	541	23,651
P. & N.Y.C. & R. Co.	....	30,084	....	....
Cumberl'd Branch Canal	....	.....	....	.....
" Railroad	....	.....	....	.....
Total	19,893	165,556	27,148	263,155
			19,893	165,556
Decrease				
Increase			7,255	97,599

The tonnage of the P. & N. Y. C. & R. R. Co. is included in that of the L. V. R..R. Co.

Philadelphia & Reading Railroad and Branches.

COAL TONNAGE

For the Week ending Saturday, February 10, 1872.

BY RAILROAD—ANTHRACITE.

PASSING OVER MAIN LINE AND LEB. VAL. BRANCH.

	Tons.	Cwt.
From St. Clair		
" Port Carbon	4,091	10
" Pottsville	8	17
" Schuylkill Haven	19,827	10
" Pine Grove	1,818	08
" Tamaqua	8,737	00
" Harrisburg		
" Dauphin	561	05
Total	35,044	10

FOR SHIPMENT BY CANAL.

Passing Frackville Scales	
" Mill Creek "	.. .
" Schuylkill Valley Scales	
" Mt. Carbon "	
" Cressona "	
" Pine Grove "	
" Tamaqua "	.....
Total	

SHIPPED WESTWARD VIA NORTHERN CENTRAL RAILROAD.

Passing Locust Gap	402 09
" Shamokin	4,036 19
" Herndon	.....
Total	4,439 08

SHIPPED WEST OR SOUTH FROM PINE GROVE.

Via Schuylkill & Susquehanna R. R.	605 18
" Lebanon & Pine Grove Branch	656 17
Total	1,262 15

CONSUMED ON LATERALS.

From Frackville Scales	26 11
" Mill Creek "	676 15
" Schuylkill Valley Scales	1,153 04
" Mt. Carbon "	461 18
" Cressona "	424 03
" Pine Grove "	39 07
" Tamaqua "	536 07
Total	3318 05

LEHIGH AND WYOMING COAL.

Received via Allentown, E. Penn'a Br.	137 18
" " Alburtis, "	
" " Oreland, G. & N. Br.	970 14
" " Connecting R. R.	
" " Willow Street R. R.	112 18
Total	1,221 10

BITUMINOUS.

From Harrisburg	4,495 12
" Connecting R. R., G. & N. Br.	
" Junction R. R.	103 14
Total	4,599 06

COAL FOR COMPANY'S USE.

Anthracite	2,085 17
Bituminous	250 04
Total.	2,336 01

RECAPITULATION

	Total for Week.	Corres-p'g week last year.	Increase and Decrease.
Passing over Main Line and Leb. Val. Branch	35,044 10	9,882 08	i 25,162 02
For Shipment by Canal			
Shipped Westward via Northern Central R. R.	4,439 08	1,170 01	i 3,269 07
Shipped West or South from Pine Grove	1,262 15	810 03	i 452 12
Consumed on Laterals	3,318 05	1,222 05	i 2,096 00
Lehigh and Wyoming Coal	1,221 10	30 00	i 1,191 10
Total Anthracite paying freig't	45,286 08	13,114 17	i 32,171 11
Bituminous	4,599 06	6,378 14	d 1,779 08
Total of all kinds paying freig't	49,885 14	19,493 11	i 30,392 03
Coal for Company's use	2,336 01	2,267 18	i 68 03
Total Tonnage for Week	52,221 15	21,761 09	i 30,460 06
Previously this year	607,241 08	599,365 13	i 7,875 15
Total to date	659,463 03	621,127 02	i 38,336 01

SHIPPED BY CANAL.

From Schuylkill Haven			
" Port Clinton			
Total Tonnage per Week			
Previous'y this year			
Total to date	13,355 16	36,225 17	d 22,870 01

Pennsylvania Coal Company.

Shipments of Pittston Coal for the week ending Feb. 10, 1872.

	1872. WEEK.	1872. YEAR.	1871. WEEK.	1871. YEAR.
By Railway	15,402 13	105,069 14	69 05	2,760 14
" Canal				
Total	15,402 13	105,069 14	69 05	2,760 14
Increase 1872	102,309 00			

Report of Coal Transported over Central R.R. of N. J. (Lehigh and Susq. Div.)

Week ending Feb. 10—Compared with same time last year.

WHERE SHIPPED FROM	WEEK 1872., tons ct	WEEK 1871. tons ct.	YEAR 1872 tons cwt.	YEAR 1871. tons cwt.
Wyoming Region	10376 18	1074 07	119650 19	39192 18
Upper Lehigh Region	3161 15		18934 17	4614 06
Beaver Meadow Region				
Hazleton Region	473 05		1580 19	704 05
Mahanoy Region				
Trescakow Region			5309 03	1043 03
Mauch Chunk Region	2145 09	716 16	19399 18	15490 04
Totals	16157 07	1791 03	104775 16	61044 16
Increase	14366 04		103731 00	
Decrease				
DISTRIBUTION.				
Forwarded East of Mch Chunk by Rail	11653 16	867 15	133314 02	55923 12
Forwarded East of Mch Chunk by Canal				
Delivered at and above Mauch Chunk	286 13	510 14	7098 05	3934 08
L. V. R. R at Packer'n	93 13	412 14	1272 05	1186 16
Delivered to L. & B. R. R.at Plymouth Bridge	4123 05		22991 03	
Totals				
Of the above there was transported on acc'nt of L. C. & N. Co.	2145 09	716 16	23718 12	16726 11
W.-B. C. & I. Co.	6058 09	68 15	84977 14	30858 48
Totals	8203 18	785 11	108696 06	47585 09
Increase	7418 07		61110 17	
Decrease				

Delaware and Hudson Canal Company.

The following is a statement of Coal Transported by the Delaware and Hudson Canal Co. for the week ending Feb. 10, 1872.

	FOR THE WEEK.	FOR THE SEASON.
By Delaware and Hudson Canal	.....	
By Railroad, East	7,479	62,588
" " West	7,010	41,360
" " South	6,041	41,280
Total Tons	20,530	145,228

For the same period last year.

	FOR THE WEEK	FOR THE SEASON.
By Delaware and Hudson Canal,		
By Railroad, East	2,502	48,332
" " West	134	12,721
" " South	.....	.....
Total Tons	2,636	71,053
Increase	71,175	

Delaware and Hudson Canal Company.

Coal mined and forwarded by the Delaware and Hudson Canal Company for the week ending Saturday, Feb. 10, 1872.

	WEEK.	SEASON.
North	43,528 14	273,056 18
South	6,041 09	37,456 18
Total 1872	49,570 03	310,513 16
Corresponding time in 1871 :		
North	Suspension.	
South	"	
Total		
Increase North		
Decrease North		
Increase South		
Decrease South		
Total decrease 1872		
Total increase 1872	49,570 03	310,513 16

Delaware Lackawanna & Western Rail Road Company.

Coal transported on the Delaware, Lackawanna and Western R. R., for week ending Feb. 10, 1872 :

	Week. Tons. Cwt.	Year. Tons. Cwt.
Shipped North	10,873 17	72,328 11
Shipped South	34,219 09	225,148 12
Total	45,073 06	297,877 03
For the corresponding time last year:		
Shipped North		
Shipped South		
Total	2,719 18	3,657 12
Increase	42,373 08	294,219 11
Decrease	.....	.....

Shamokin Coal Trade.

For week ending February 10, 1872	7,530 18
Same time last year	3,967 00
Increase	
Decrease	3,563 18
Total amount shipped to date	30,800 02
Same time last year	33,158 03
Increase	
Decrease	2,352 01

Statement of Coal Transported over Cumberland and Pennsylvania Railroad

During the week ending Saturday Feb. 10, and during the year 1872, compared with the corresponding period of 1871.

WEEK.

	To C. & O. Canal. Tons. Cwt.	To B.&O.R.R. Co Tons Cwt.	Total. Tons. Cwt.
1872	.....	17,546 14	17,546 14
1871	.....	8,999 19	8,999 19
Increase			8,546 15
Decrease			

YEAR.

1872	.....	103,163 18	103,163 19
1871	.....	63,376 12	63,376 12
Increase	.....		39,787 07
Decrease			

Report of Coal Transported over Lehigh Valley Railroad

Report of coal tonnage for the week ending Feb. 10, 1872, with totals to date, compared with same time last year.

WHERE SHIPPED FROM.	WEEK. Tons. Cwt.	TOTAL. Tons. Cwt.
Total Wyoming	6,014 00	95,777 09
" Hazleton	34,076 05	316,616 06
" Upper Lehigh		616 16
" Beaver Meadow	9 881 09	126.952 19
" Mahanoy	2,516 12	43.079 04
" Mauch Chunk		495 08
Total	52 488 06	583,538 02
Same time last year	2,247 17	383,632 14
Increase	50,240 09	199,905 08
Decrease		
Forwarded East from Mauch Chunk by rail	42,608 06	513,984 13
Same time last year	1,550 1	335,115 19
Increase	44,057 16	178.868 14
Decrease		

DISTRIBUTED AS FOLLOWS.

Forwarded East from Mauch Chunk by rail	45,605 04	502,917 10
do East for use L. V. R. R	1,003 02	11,037 03
Delivered at and above Mauch Chunk for use of L. V. R. R	640 02	12,078 06
To P. & N. Y. R. R	4,777 08	42,5.6 02
To N. C. R. R. at Mount Carmel		73 06
To D. H. & W. R. R.	626 12	2,163 04
To L. & S. R. R. at Packerton for rail	517 15	2,6 4 04
Delivered at M'h Chunk	49 04	905 10
Delivered on line of road above Mauch Chunk	263 19	4,992 12
To L. & S. R. R., at Penn Hav., for railroad		3,638 11
Do. for canal		864 07
To Lehigh Canal Mauch Chunk		19 07
Total	52,488 06	583,538 02

Prices of Coal by the Cargo.

[CORRECTED WEEKLY.]

SCHUYLKILL.	AT NEW YORK, Feb. 16. R. A.	W. A.	AT PHILADELPHIA Feb. 16. R. A.	W. A.
Lump	$—	$—	— —	
Steamer	— —	— —	— —	— —
Broken	— —	— —	— —	
Egg	— —	— —	— —	— —
Stove	— —	— —	— —	— —
Chestnut	— —	— —	— —	
Pea	— —	— —	— —	— —
LEHIGH.				
Lump, (along side)	5 00	— —	— —	— —
Broken	4 75	— —	— —	— —
Egg	4 50	— —	— —	— —
Stove	5 25	— —	— —	— —
Chestnut	4 25	— —	— —	— —
Pea	— —	— —	— —	— —
SPECIAL COALS.*				
Honey Brook, Le'h W. A.	4 00@4 75		— —	— —
Spring Mountain " "	— —@—		— —	— —
Sugar Creek " "	— —@—		— —	— —
Sugar Loaf " "	— —@—		— —	— —
Old Comp'y's " "	4 00@4 75		— —	— —
Room Run " "	4 00@4 75		— —	— —
McNeal " "	— —		— —	— —
Girardville " "	— —		— —	— —
Hill & Harris " "	— —		— —	— —
Shamokin " "	— —		— —	— —
Lykens Valley " "	— —		— —	— —
Broad Top " "	— —		— —	— —
McMichael " "	— —		— —	— —
Henry Clay " "	— —		— —	— —
Powelton "	— —		— —	— —

Dealers in these coals may be found in our advertising columns.

Company Coals.

Feb. 1872.

	L.	Str.	Gra.	Eg.	Sto	Chest
*Scranton at E. Port	3 39	3 77	3 63	4 02	4 10	3 34
*Pittston at Weehawken	4 00	4 00	4 15	4 25	4 50	4 00
*Lackawana at Weehawken	3 75	3 75	3 85	3 85	4 25	3 75
Wilk'b're at Hoboken	3 75	3 75	3 85	3 85	4 25	3 75
Old Co Lehigh at PtJohn'n	4 75	—	4 00	4 00	4 50	4 00
Lehugh at Eliz. Port	4 75	—	4 00	4 00	4 50	4 00

For freights to different points see "Freights."
* To contractors only.

Prices of Gas Coals.

Feb, 1872.

PROVINCIAL.

Corrected weekly by Louis J. Belloni, Jr., 41-43 Pine st., N. Y

Duty, $1 25, gold

	Coarse	Slack.
Block House	$1 50 @	1 75
Gowrie	1 60 @	1 75

Corrected by Bird, Perkins & Job, 86 South street.

	Coarse.	Culm of Coal,
Pictou	$2 25 @	1 25
Sydney	2 25 @	80
Lingan	1 60 @	80
Little Glace Bay	1 60 @	1 00
Caledonia	1 60 @	80

A discount from the prices of the coarse Coal on purchase of 5000 tons and upwards. Duty $1 25 per ton, gold, on the coarse coal. 25 per cent. ad valorem on the Culm of Coal

AMERICAN.

	Currency.
Westmoreland	$7 00 @— —
Fairmount Gas Coal Co. of N. Y.	7 00 @— —
Despard Coal Co	7 00 @— —
Penn	7 00 @— —
Newburg Orrel Gas	— — @— —
West Fairmount Gas Coal	7 00 @— —

AT PHILADELPHIA.

Powelton	$6 75

TO NEW YORK.

Provincial.	
Sidney	$3 25
Lingan	3 25
Cow Bay	3 37½
Port Caledonia	3 37½
Little Glace Bay	3 25

Prices of Foreign Coals.

Feb, 1872.

Duty $1 25 per ton.

Corrected weekly by PARMELE BROS., No 32 Pine street, N. Y.

Liverpool Gas Caking	$ 8 00@— —
" Cannel	12 00@13 00
" House "	18 00@20 00
" Orrel	14 00@16 00

Per ton 2,240 lbs., ex-ship.

PRICES FROM YARD.

Liverpool House Orrel, screened	$16 00@17 50
" Cannel, "	20 00@25 00

Per ton 2,000 lbs. delivered.

Rates of Transportation to Tide Water.

BY RAILROAD.

TO PORT RICHMOND, PHILADELPHIA.

Philadelphia and Reading Railroad, from Schuylkill Haven for consumption	$1 25
For reshipment	

MAUCH CHUNK TO ELIZABETHPORT.

L. V. Railroad from Mauch Chunk to Phillipsburgh	$0 64
C. R. R., N. J., Phillipsburgh to Elizabethport	0 95
Shipping expenses at Elizabethport	25
Wharfage	10
Total	$1 94

MAUCH CHUNK TO PORT JOHNSON.

L. V. R.R., or L. & N. R.R. from M. C. to Phillipsb'g	$0 64
C. R. R., of N. J., Phillipsburgh to Pt. Johnson	0 95
Shipping expenses	25
Wharfage	10
Total	$1 94

TO HOBOKEN.

L. V. R. R., Mauch Chunk to Phillipsburgh	64
Morris & Essex R. R. Phillipsburgh to Hoboken	0 95
Shipping expenses	25
Wharfage	10
Total	$1 94

TO SOUTH AMBOY.

L. V. R. R.	72
B. & D. R. R. } Cam. & Amb. R. R. }	91
Shipping Expenses,	35
Total	$1 08

PENN HAVEN TO ELIZABETHPORT.

L. V. R R. Penn Haven to Phillipsburgh	0 75
C. RR. of N. J. Phillipsburgh to Elizabethport	0 95
Shipping expenses	25
Wharfage	10
Total	$ 2 05

Freights.—Feb. 1872.

TO EASTERN PORTS.	Cumberland. From Georgetown.	Cumberland. From Baltimore.	Anthracite. From Philada.	Anthracite. From Elizabethport, Port Johnson, and Hoboken.	Anthracite. From Newburg...	Anthracite. From Rondout...
Amesbury						
Bangor						
Bath						
Boston		3 85		2 75		
Bridgeport		3 25				
Bristol						
Derby						
Dighton						
East Cambridge		3 50				
Fall River						
Hackensack		3 25				
Hartford						
Hartford	2 25					
Jersey City		2 25		55		
Middletown						
Mystic						
New Bedford		3 50				
Newburyport		4 25				
New Haven		3 25		1 00		
New London		3 25	3 50	1 25		
Newport				1 66		
New York		2 50		55		
Norwalk				1 05		
Norwich						
Pawtucket						
Portland		4 00		2 50		
Portsmouth, N. H						
Prov. dence		3 25		1 60		
Rockport						
Saco						
Sag Harbor						
Salem		4 00		2 75		
Stamford						
Stonington				1 50		
Taunton						
Warren						
Washington						
TO RIVER PORTS.						
Albany						
Catskill						
Cocksackie						
Coeyman's						
Cold Spring						
Fishkill						
Haverstraw						
Hudson						
New York						
Nyack						
Poughkeepsie						
Rhinebeck						
Rondout						
Saugerties						
Sing Sing						
Stuyvesant						
Tarrytown						
Troy						
West Point						
Yonkers						

MARKET REVIEW.

FOR THE WEEK ENDING FEBRUARY 17, 1872.

IRON.—The market for Scotch Pig remains in about the same position as last noted. The demand continues light, but there is no disposition on the part of holders to realize, and prices are steady at the late advance—we notice sales of 200 tons Glengarnock at $39,75a$40; and 300 do. Eglinton and Langloan, on private terms. The market for American is very firm, with a good inquiry and very small offerings—sales have been made of 300 tons of No. 1 Crane at Hoboken at $40; and 500 do. Gray Forge, part $38,25. Wrought Scrap continues in request and prices remain firm—300 tons sold on private terms. There has been an improved demand for American, Rails, and prices are in sellers favor. English are quiet but steady at former quotations—8000 tons American and 600 do. old Double-headed sold on private terms. Refined Bar from store was again advanced yesterday $2,50 per ton, bringing Sweeds Bar to $115a$127,50—English and American Refined Bar, ¾ to 2 inches, round and square, $1 to 6 inches wide by ¾ to 1 inch thick $97,50—do. 1¼ to 6 by ¼ and 5-16 and 2½ to 3, round and square, $102,-50—do. 1 and 1¼ by ¼ and 5-16, $105—Scroll $115a$145—Oval and Half Round, $112 50a$132 50—Band $110—Horse Shoe $110a$120—Rods ⅜a3-16 inch $102,50a$137 50—Hoop $117,50a$165—Large Rounds $107,50 for 3¼a3½ inch—$112,50 for 3¾a4 inch,—$125 for 4¼a4½, and $135 for 4¾a5, net cash, per ton—Nail Rods 7¼ cents per lb. Steel was not changed. Common Sheets are held firmly at 5½a6 cents, and R. G. Charcoal, 6½ for No. 24 and under, 6¾ for 25, 26, and 27, and 7 for 28, cash.

PHILADELPHIA, February 12.—EDWARD SAMUEL reviews the week as follows:—With the exception of an advance in new Rails, there is no change to note. Pig Iron is firm at quoted prices, all the best brands being entirely out of the market. Manufactured Irons are unchanged, but will undoubtedly advance. We quote: American No. 1, Foundry Pig, $39a$40; No. 2, $37a$38; No. 3, Forge, $35a$36; No. 4, White and Mottled, $34a $35; Refined Bar, (mill price), $87,50a$90; Common, $80 a$82,50; and Rails (at mill), $73a$75.

LEAD.—Foreign Pig is very quiet, but prices are nominally as before—say $5,90a$6 for ordinary. Bar 9¼ cents, Sheet and Pipe 10, and Tinlined Pipe 15, less 10 per cent, to the Trade.

MARVIN T. REED, of the house of THOMAS OTIS, LEROY & Co., New York, Lead manufactures, made a long argument before the Finance Committee in Washington yesterday in favor of reducing the duty on Pig Lead. He reviewed the importations, exports, and home productions for the past twenty years, showing that while the duties have been largely increased home productions rapidly decreased, and the price rapidly advanced. In 1846 our mines produced enough for home consumption and for exportation to the amount of $50,000 a year, while now the importations are ninety-three million pounds a year. The home production is only one-fourth that amount, and the United States do not export a pound of Lead, Nearly all the Lead produced in this country is mined in Illinois; but St. Louis and other Western cities are obliged to draw on imported Lead from seaboard cities to supply their local manufacturing demand. The consumption of Pig Lead is about one hundred and thirty million pounds annually, and at the current rate of increase the consumption ten years hence will reach over two hundred million pounds. Mr. REED urged the repeal of all duty on Pig Lead, because the present gives long established foreign rivals the monopoly of all the markets of the world, and excluded our manufactures from Canada, the West Indies, and South America.

COPPER.—Ingot has become quiet. Manufacturers buy very sparingly, and there is a pause in the speculative demand. Prices, however, are firm; the sales embrace about 15,000 lbs. Lake at 28¼a28¾ cents, mostly for delivery 15th inst. at 28¼—for March 28½a28⅞ cents is asked.

STEEL.—We have as yet no changes to notice in price in this market—there is always a disposition to keep the currency quotation for lots from store uniform without regard to the fluctuations in gold; and there seems an equal indisposition to advance with the foreign market, probably on account of the advantage it would give to the American made.

TIN.—There has been no business in Pig, and we retain our previous quotations, but they are wholly nominal, say Banca 41 cents, and Straits and English 36½ gold. For Plates, there is a renewed demand, and the sales have been large; the market is very strong for all kinds, and at least 25 cents gold per box higher yesterday for I. C. Charcoal Tin. Sales have been made of 300 bxs. Charcoal Tin, assorted, at $10,25 for I. C.; 1000 do., $10,37½; 1000 do., $10,37½ a $10,50; 250 do. Coke, 9,37½; 3400 do., 10 by 14, $9,25 a $9,37½; 100 do., 12 by 12, $9,50; 1500 do. Charcoal Terne, $9,25 a $9,50; 1000 do. to arrive, $9,12½ a $9,25; 500 do. B. C. Coke Terne, $8,25; 500 do. A. G. triangle, $8,37½; and subsequently, 300 do. same brand, $8,66½, cash, all gold.

SPELTER—Foreign is very quiet. Prices are nominally 7 a 7¼ cents gold, as to brand.

ZINC—Sheet is steady and firm at our quotations, with a moderate demand. Am. ox. being quoted at 7 a 7½; French, 9¼ a 9½ Sheet, 10½ a 11; Manganese 4 a 4½.

METALS.

NEW YORK, Feb. 17, 1872.

IRON.—Duty: Bars, 1 to 1¼ cents ℔ lb; Railroad, 70 cents ℔ 100 lbs.; Boiler and Plate, 1½ cents ℔ lb; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾ cents ℔ lb; Pig, $7 ℔ ton; Polished Sheet, 3 cts. ℔ lb; Galvanized 2½; Scrap Cast, $6; Scrap Wrought, $8 per ton.

	Store Prices.
Pig, Scotch No. 1, ℔ ton	37 00@42 00
Pig, American, No. 1	41 00@42 00
Pig, American, No. 2	38 00@39 00
Pig, American, Forge	38 00@39 00
Bar Refined, English and American	— —@86 00
Bar Swedes, assorted sizes (gold)	$5 00@100 00

	Store Prices, Cash.
Bar, Swedes	115 00@125 00
Bar, Refined, ⅜ to 2 in. rd. & sq. 1 to 6 in. x ¾ to 1 in.	97 50@— —
Bar, Refined, 1¼ to 6 by ¼ & 5-16 & 2⅝ to 2⅞ rnd. sq.	102 50@— —
Bar, Refined, 1 & 1¼ by ¼ & 5-16	105 00@— —
Scroll	115 00@145 00
Ovals and half-round	112 50@132 00
Band	— —@110 —
Horse Shoe	110 00@120 —
Rods, ⅜ to 3-16 inch	102 50@137 50
Hoop	117 50@165 00
Nail rod	7½@— 09
Sheet, Russia, as to assortment (gold)	15 — —
Sheet, Single, D. and T. Common	—5½@— 6
Sheet, D. an 3 T. Charcoal	—6½@— 7
Sheet, Galv'd, Nos. 10 to 27	10@15c lb.
" " Nos. 2s, and 29.	15@19c lb.
Rails, English (gold), ℔ ton	63 00 @65 00
Rails, American, at Works in Pa.	71 00 @73 00

COPPER.—Duty: Pig, Bar, and Ingot, 5; old Copper 4 cents ℔ lb; Manufactured, 45 per cent. ad val.

	All Cash.
Copper, New Sheathing, ℔ lb.	— @— 34
Copper Bolts	— @— 36
Copper Braziers, 16oz. and over	— @— 36
Copper Nails	— @— 40
Copper, Old Sheathing, &c. mixed lots	25½@— 26
Copper, Old, for chemical purposes, 14@16 oz.	— @— —
Copper, American Ingot	28¼@— 28⅝
Yellow Metal, New Sheathing & Bronze	— @— 26
Yellow Metal Bolts	26 @— —
Yellow Metal Nails	— @— 26

LEAD.—Duty: Pig, $2 ℔ 100 lbs.; old Lead, 1½ cents ℔ lb; Pipe and Sheet, 2½ cents ℔ lb.

Galena, ℔ 100 lbs.	$— — @— —
Spanish (gold)	5 90 @6 00
German, do.	5 90 @6 00
English do.	5 95 @6 25
Bar (net)	9 25 @— —
Pipe (net)	— — @10 00
Sheet	— — @10 00

Colwell, Shaw & Willard Tin-Lined Lead Pipe 15 cts. ℔ lb.

STEEL.—Duty: Bars and ingots, valued at 7 cents ℔ lb or under, 2¼ cents; over 7 cents and not above 11, 3 cents ℔ lb; over 11 cents, 3¼ cents ℔ lb, and 10 ℔ cent ad val. Store prices.

English Cast (2d and 1st quality) ℔ lb	— 15 @— 18
English Spring (2d and 1st quality)	— 7 @— 10
English Blister (2d and 1st quality)	— 10 @— 17
English Machinery	— 11 @— 13
English German (2d and 1st quality)	— 10½@— 12
American Blister "Black Diamond"	— — @— 12
American, Cast, Tool do.	— 15 @— 16
American, Spring, do.	— 9 @— 11
American Machinery do.	— 9 @— 10
American German, do.	— 9 @— 11

TIN.—Duty: Pig, Bars, and Blocks, 15 ℔ cent. ad val.; Plate and Sheets and Terne Plates, 25 ℔ cent.; Roofing 25. ad val.

	Gold ℔ lb.
Banca	— @41
Straits	36¼@—
English	36½ @—

PLATES.

Fair to Good Brands.	Gold.	Currency.
I. C. Charcoal, ℔ box	$10 37½@10 50	$11 50 @12 00
I.C., Coke	9 75 @ 9 50	10 50 @11 00
Coke Terne	8 00 @ 8 50	9 25 @ 9 75
Charcoal Terne	9 25 @ 9 50	10 50 @11 00

SPELTER—Duty: In Pigs, Bars & Plates, $1.50 p. 100 ℔

Plates, Foreign (gold) p. 100 lb.	7 00 @ 7 25
Plates, Domestic p. lb.	— 7 @— 11

ZINC.—Duty: Pig or Block, $1.50 per 100 lb.; Sheet 2½c per lb

Sheet per lb.	— 10½@—11

San Francisco Stock Market.

BY TELEGRAPH.

The following report from the San Francisco Stock Market, is dated the 13th inst.; excepting a decided advance in Gould & Curry, the market has materially declined, a fact which is not to be wondered at, considering the remarkable advance of the Washoe list, during the excitement of last week. Undoubtedly there as here if the least excuse is offered for carrying stocks up, the interested ones are not slow to avail themselves of such an opportunity, especially if the result accrues to their benefit, and not unfrequently "as per many examples furnished" they are carried far above their natural level by the uninitiated, while the manipulators reinstate the Stocks to their normal condition, not neglecting to pocket the difference. By advices per Associated Press dated the 9th inst., as annexed it will be observed, that he present decline, as compared with that report is regular and uninterrupted.

	Feb. 13.	Feb. 9
Savage	230	235
Yellow Jacket	73	73
Kentuck	244	230
Chollar Potosi	66	72
Gould & Curry	210	267
Belcher	—	625
Crown Point	—	760
Ophir	—	95
Alpha	—	32
Imperial	85	105
Eureka G V	19	—
Meadow Valley	—	—
Amador	—	—
Hale & Norcross	—	235

Mining Stocks.

The following is the list of Gold stock quotations, as furnished by the Mining Stock Board, on the 12th inst., 100 shares of Central Gold changed hands, at 2 cts. per share; on the 13th, 100 Gregory sold at 20 cts., and 500 Lacrosse at 19. To-day 100 Smith & Parmlee sold at 16 which comprises the sales for the week.

	BID.	ASKED
American Flag	—	20
Bates & Baxter	25	—
Benton	—	10
Black Hawk	30	50
Central Gold	—	—
Cons Gregory	15	—
Grass Valley	3	—
Gunnell	8	—
Holman	—	—
La Crosse	17	20
Liberty	—	—
Mariposa prf.	—	—
Montana	—	—
Rocky Mount.	—	5
Quartz Hill	—	—
Smith & Parmlee	17	20
N. Y. & Eldorado	—	—

About-Town Jottings.

BUSINESS AND PERSONAL.

Personal announcements and business notices, inserted in this column, at fifty cents per line.

Geo. F. Blake & Co., 79 Liberty street, Steam Pumps of every size and capacity, for all purposes.

Utica Steam Engine Co. (formerly Wood & Mann Steam Engine Co.), 42 Cortlandt street, N. Y.

Post & Goddard have removed to No. 111 Liberty street. Dealers in Taps, Dies, Reamers, Drills, and supplies generally.

Roper Caloric or Hot Air Engine, 124 Chambers St.

Peteler Portable R. R. Tracks and Cars. Miners and contractors, send for circulars, 42 Broadway, N. Y.

American Submerged Pump. Power attachment—cheapest and best in the market, 55 Chambers st. N. Y.

Baxter Portable Engine, 18 Park Place, N. Y.

Chas. S. Parker is the only special advertising agent connected with the "JOURNAL."

RICHARD H. BUEL, Consulting Mechanical Engineer, 7 Warren St., New York.—Professor R. H. Thurston, of the Stevens Institute of Technology, has consented to associate himself with me in consultation on matters of special importance. I have enjoyed considerable experience as an engineer officer in the U. S. Navy, in actual service afloat, as Principal Assistant to the Chief Engineer of the Norfolk Navy Yard, and as Assistant Professor of Natural and Experimental Philosophy at the U. S. Naval Academy. I have also been engaged in the management, erection and repairs of saw-mills and other machinery in the South; as Principal Assistant Engineer of the Tehuantepec and Nicaragua Surveying Expedition, and as Professor of Mathematics, *ad interim*, at the Stevens Institute of Technology. I have at command a large and varied assortment of instruments used in testing engines, boilers and other machinery. Machinery of all kinds bought and sold. Advice and assistance given to those who desire to invest funds in meritorious and valuable Patent Rights. Special attention will be given to expert practice in legal cases. I have permission to refer to a number of gentlemen well known in professional circles.

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MINING & RAILWAY CONTRACTORS, SINKERS, &c.
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feb.20 t.f Penn.

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ANALYTICAL and CONSULTING CHEMIST
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CHEMIST AND METALLURGIST,
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Wilkesbarre Coal & Iron Co.
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Orders received for
SHIPMENT BY RAIL
DIRECT FROM MINES,
OR FOR
RESHIPMENT FROM COMPANY'S WHARVES,
AT
Port Johnson and Hoboken, New Jersey.

DETMOLD & COX,
ANTHRACITE AND BITUMINOUS
COALS.
Office, 40 Trinity Building, New York. jan 23:1y

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MINED BY THE
CONSOLIDATION COAL COMPANY,
Of the best quality for manufacturing, steam generating, and domestic purposes.
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mch7;tf Baltimore.

THE NEWBURGH ORREL COAL COMPANY
Mines at Newburgh, Preston Co., W. Va.
Company's Office, No. 52 S. Gay St. Baltimore, Md.
C. OLIVER O'DONNELL.....President.
CHAS. MACKALL.....Secretary
This Company offer their very superior Gas Coal at lowest market prices.
It yields 10,996 cubic feet of gas to the ton of 2,240 lbs. of good illuminating power, and of remarkable purity; one bushel of lime purifying 6,792 cubic feet, with a large amount of coke of good quality.
It has been for many years very extensively used by various Gas Companies in the United States, and we beg to refer to the Manhattan, Metropolitan, and New York Gas Light Companies of New York, the Brooklyn and Citizens' Gas Light Companies of Brooklyn, N. Y., the Baltimore Gas Light Company of Baltimore, Md., and Providence Gas Light Company, Providence, R. I.
The best dry coals shipped, and the promptest attention given to orders. sep21-1y

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ANTHRACITE COALS.
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From Port Johnston and Jersey City,
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SEMI-BITUMINOUS,	GEORGES CREEK,	GEORGES CREEK,
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☞ Reference to them is requested. may30-1y

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jan23:1y JOHN K. SHAW, Vice President.

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DEPARTMENT OF POPULAR SCIENCE.

The Art of Counting.

It is an old dispute among philosophers whether "two and two make four" is a necessary truth, or a truth of experience, an innate or an acquired idea. Mr. Mill declares that the fundamental truths of the science of Number all rest on the evidence of sense. Thus "five and five are ten" is merely the expression of the invariable experience that ten objects may be separated into groups in many different ways, and that five and five are the same as seven and three, or five, three and two, etc. Addition is thus a mere form of numeration; or, as may be said with equal accuracy, numeration is addition. In fact, children and savages add before they count, and counting is but a method of expressing the result of addition.

Ethnological and philological researches throw much light upon the growth of this art. (Let the student who would find the evidence upon this subject compactly and clearly stated consult Edward B. Tylor's "Primitive Culture.") Both the indications civilized arithmetics and the rudimentary forms still existing among barbarous tribes point to the practice of counting by the fingers and toes as the measure of numbers. The lowest tribes of South America and Australia are reported to have no numerals higher than three, and to use this to mean an indefinite number. Thus the Tasmanians are said to count "one, two, plenty." But this is perhaps doubtful, like all observations of travellers not intimately acquainted with native languages. I have found among some North American tribes a disinclination to use higher numbers, or a great vagueness in their use, though their languages afforded the means of such numeration when necessary. And savages who cannot or do not count in words beyond 3 or 5 can and do go further by gestures.

The art of counting may be developed by circumstances beyond the average level of the civilization of the tribe. The habit of bargaining is one of the greatest causes of such development. The West Africans are notably good arithmeticians, and the Yorubas of Abeokuta have a proverb "You may think yourself clever; but you can't tell nine times nine," that is, you are a dunce. Mr. Tylor points out the contrast between this and the corresponding European sayings, German, Spanish and English, which speak of the inability to count five, or "know how many beans make five," as the limit of stupidity. The Tonga Islanders have native numerals up to 100,000; and a French explorer, by persistent questioning, obtained from them numerals up to 1,000 billions, which were duly printed. But it proved afterwards that the bored savages had "stuffed" the inquisitive Frenchman, giving him for these higher numbers a series of nonsense words and indecent expressions—a warning to all travellers!

The numerical systems of men show a remarkable similarity in one respect. They are almost without exception either quinary, decimal or vigesimal (that is, based upon the number five, or ten or twenty) or combinations of these bases. This corroborates a mass of philological and ethnical evidence that the art of counting originated in the use of hands and feet as aid to numeration. Thus remote and independent tribes have been led to call the number 5 by the name for *hand*; 10 by *two hands*, or *half a man*; 15 by the addition of a *foot*; and 20 by *hands and feet*, or *one man*. The Greenlanders say for 13, *on the first foot three*; for 18, *on the other foot three*; for 53, *on the third man on the first foot three*.

The original meaning of the names given to the lower numerals, 1, 2, 3, etc., is obscure, especially in civilized languages—a fact which may be explained by the great antiquity of the terms, and by the natural effect of their necessarily continuous use as numerals, in obliterating their use as names of objects. I do not mean that we cannot trace their etymology back to ancient tongues (*i. e.*, English *two*, Latin and Greek *duo*, Sanskrit, *dwi*), but that however far we follow them, they are still numerals. It is as if our words *pair* (Latin *par*, "equal,") or *couple* (Latin, *copula* "a tie") should be substituted and exclusively used for *two*, until the original meaning were forgotten. But it is probable that the digit numerals originally referred to natural objects, as do the words arbitrarily chosen centuries ago by the scholars of India, to serve as technical aids in recording and remembering numbers. In this artificial system, *moon* or *earth* stood for 1, because there is but one moon or earth; *eye, wing, arm* or *jaw*, for 2, because these go in pairs; *season* for 6, because they reckoned six seasons; *sage* or *vowel* for 7, because they recognized seven sages and seven vowels; *sun* or *zodiac* for 12, with reference to the twelve signs, and so on.

The evidence drawn from the universality of quinary and decimal systems, in favor of the gradual and independent growth of the art of counting in different tribes, out of the practice of reckoning by fingers and toes, is all the stronger since these systems are by no means theoretically the best in notation. If arithmetic had been divinely revealed to men, or if it could now be reconstructed in the light of experience, there is no doubt that we should have an octonary instead of a decimal system, and should thus escape much trouble with fractions. Halves, quarters, and eighths are the commonest subdivisions, and must always so remain, because they can be easily and accurately determined in weight or measure; while tenths are difficult of determination. Accordingly, we are accustomed to use in common life a partial octonary system, which we translate into decimals when we must. If the savages who forged for us this fettering system, which we shall never throw off, had only forgotten to count their thumbs and great toes, how much easier would be our arithmetic!

The Roman notation hints the whole history of the art. It has the rudiments of our Arabic system, by which a certain number of units of one denomination are represented by a single symbol of another. In our better method, however, the symbol shows the number, and the place the denomination, while the Romans could only indicate the number by repeating the symbol, and thus partially destroying the definite significance of the place. Their progression was a curious combination of the quinary and the decimal, their modulus being, not 10, but alternately five and two. Thus, where we say "10 units make one ten, 10 tens make one hundred," etc., the Roman schoolboys may have been accustomed to chant:

> "*Quinque I unum V faciunt;*
> *Duo V unum X faciunt;*
> *Quinque X unum L faciunt;*
> *Duo L unum C faciunt;*
> *Quinque C unum D faciunt;*
> *Duo D unum M faciunt.*"

Is there not, possibly, in this alternation of five and two, a trace of the change in counting from one hand to the other? Thus a man holds up a finger (I) for 1, a whole hand (V) for five, two hands (X) for 10; then, wishing to denote a number of tens, he displays the two hands a certain number of times, or, to abbreviate the operation, holds up, with some sign of multiplication, two, three, or five fingers, to indicate 20, 30, or 50. It is natural that he should pause at 50, since that exhausts his multiplying hand; and 100, which exhausts the multiplying resources of both hands, requires a fresh symbol and a new start. Whether the sign V is an open hand, and the sign I a finger, or not, the analogy between this notation and finger-counting is deep and true.

R. W. R.

Mechanical Puddling.

One of the most valuable and important additions to the literature of iron manufacture has appeared in the form of a report of the English committee appointed to examine into the merits of Danks' puddling furnace.

The report is very long, and occupies the whole number of the *Journal of the Iron and Steel Institute* (English). It is needless to say that the report is favorable to the American invention. We hope to give an abstract of the report in our next issue, which the crowded state of our columns renders impossible at present. We can only say that the investigation of the committee seems to have been thorough. They witnessed the practical working of the process in a number of places, and under various circumstances, and they carried back samples of the fireproof materials, ores, etc., used.

American Institute of Mining Engineers.

OFFICIAL BULLETIN.

Announcements to Members and Associates.

I. It is believed that several names of members and associates elected at the Bethlehem meeting in August, 1871, have been accidentally omitted by reason of the loss of a portion of the records of that meeting, Such persons, or their friends, are requested to communicate with the Secretary.

II. All members and associates who have not paid their dues are requested to do so at once, by sending in postal orders, or check, or money, ten dollars to the Secretary.

All members and associates who pay their dues for each current year, strictly in advance, will have sent to their address, regularly and weekly, the Engineering and Mining Journal, which is the organ of the Institute, and will contain the proceedings and transactions, and all important papers read before the Institute, and all notices of meetings. Back numbers cannot, as a general rule, be sent.

III. It is expected that the more important papers read before the Institute, and the debates thereon, will be published in annual or semi-annual volumes, to which those members and associates will be entitled who have paid their dues.

IV. Authors of papers are requested to notify the Secretary in advance of the meetings, giving the subject and length of their papers. Attention is also called, in this connection, to Rules 12 and 13.

V. The next meeting of the Institute will be held in Philadelphia, beginning on Tuesday, February 20, 1872, at 8 P. M. The Council will meet at 3:30 P. M. of the same day. Messrs. Lesley, Drown, Blandy, Frazer, Gaujot, and Lyman are the Local Committee of Arrangements. The sessions will be held at the University of Pennsylvania, in Ninth street, above Chestnut, and the headquarters of members will be at the Bingham House, corner of Eleventh and Market streets.

Communications suggestions, or questions may be addressed to

T. M. Drown, 209 South Sixth street, Phila.
J. F. Blandy, 410 Walnut street, Phila.
B. S. Lyman, 135 South Fifth street, Phila.
Persifor Frazer, Jr., 139 S. Fifth st., Phila.
Martin Coryell, Secretary, Wilkesbarre, Pa.

Progress of Silver Mining in Montana.

The new smelting works at Helena, Montana, are reported to be a decided success. Since this has become generally known in the Territory, a great deal of prospecting for lead and silver ledges has taken place, especially in the vicinity of Helena and Jefferson. The discovery of several fine ledges is said to be the result. Most of them are already vigorously worked. A very large vein of argentiferous galena has been discovered two miles from the Gregory, in the Jefferson mines, but on the Boulder slope. It has the extraordinary width of 21 feet, but assays only from $45 to $100 in silver per ton. But as the lead ores are reported to occur so solid that they may at once be used at the furnace, the discovery is an important one.

The legislature has adjourned. About its last act was the passing of a bill removing the capital from Virginia City to Deer Lodge, the resolution to be ubject to a vote of the people in August next.

THE ENGINEERING AND MINING JOURNAL.

ROSSITER W. RAYMOND, Ph. D.,
WILLARD P. WARD, M. E.
Editors.

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THE ENGINEERING AND MINING JOURNAL *is projected in the intent of furthering the best interests of the Engineering and Mining public, by giving wide circulation to original special contributions from the pens of the ablest men in the professions. The careful illustration of new machinery and engineering structures, together with a summary of mining news and market reports, will form a prominent feature of the publication.* It is the Organ of the American Institute of Mining Engineers, and is regularly received and read *by all the members and associates* of that large and powerful society, *the only one of the kind in this country.* It is therefore the best medium for advertising all kinds of machinery, tools and materials used by engineers or their employees.

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American Institute of Mining Engineers.

As will be seen in the official bulletin of the Institute, in another column, the quarterly meeting commences to-day in Philadelphia. We trust that it will be fully attended, as the proceedings promise to be highly interesting and profitable. Among the papers already announced to the Council are several of novelty and importance, relating to the mining, reduction and manufacture of iron. Perhaps the most generally attractive will be the address of Mr. A. L. HOLLEY on Rolling Mill Machinery, of which we recently gave an imperfect sketch, and which we are very glad to learn he has consented to repeat before the Institute. This lecture, as our readers are aware, is admirably illustrated with the magic lantern. As it will doubtless be impracticable to reproduce it in the ENGINEERING AND MINING JOURNAL, those who do not wish to await its future publication in more permanent form should attend the Philadelphia meeting to hear and enjoy it. When it was first delivered (in the technical course of the Stephens Institute, Hoboken), engineers and metallurgists came from distant places to avail themselves of the privilege of listening to it; and we do not doubt that many Pennsylvania ironmasters will visit Philadelphia this week for the same purpose.

Trial of the Pyx.

THE annual assay of the gold and silver coins reserved for the purpose from the delivery of coins in 1871, has just been completed at the Philadelphia Mint by a Board of Commissioners designated by the President, as follows:

Prof. Joseph Henry, of the Smithsonian Institute; Prof. John Torrey, United States Assay Office, New York; Rev. F. A. P. Barnard, President Columbia College, New York; Prof. Fairman Rogers, Philadelphia; Hon. George H. Stuart, Philadelphia; John Jay Knox, Deputy Comptroller of the Currency, Washington; Colonel Robert F. Stevens, late Director of the Mint at San Francisco; Prof. W. P. Blake, New Haven, Connecticut; Samuel A. Green, M. D., Boston, Massachusetts; Prof. George Davidson, United States Coast Survey; Hon. R. W. Taylor, First Comptroller of the Treasury at Washington.

In addition to these, Hon. John Cadwalader, Judge of the United States District Court; Hon. Aubrey H. Smith, United States District Attorney; and Hon. J. W. Forney, Collector of the Port of Philadelphia, are *ex officio* members of the Committee.

The first duty of the Commission is to receive and count the samples of gold and silver coin from the Mint and its auxiliaries. The coins are then carefully weighed in mass and in single pieces upon accurate balances, by which the slightest deviation from the legal weight is quickly shown. About $1,000 of the beautiful new gold coins from each mint are then melted into ingots from which the sample chips are cut for assay. Single coins are then cut up and are separately assayed. The whole of the operations are performed with the greatest care and accuracy, and the results are reported in writing in detail to the Secretary of the Treasury.

The only places where gold is now coined by the United States are Philadelphia, San Francisco and Carson City. At Philadelphia, $3,206,760 in gold where coined in the fiscal year ending June 30, 1871; at San Francisco, $24,241,006; and at Carson City, $230,715. The total gold and silver deposits exceeded those in the previous year by more than two million of dollars. Of the gross sum of our gold coined, two-thirds or more is exported, and on reaching the Bank of England is sent at once to the melting pot and put into bars for recoinage.

The annual assay of the Royal British Mint, similar to that which has just been made at Philadelphia, is called "The Trial of the Pyx," the word pyx (from the Greek *puxos*, the box-tree) signifying the box in which the sample coins are kept.

New Publications.

THE METRIC SYSTEM OF WEIGHTS AND MEASURES. *An Address delivered before the Convocation of the University of the State of New York at Albany, August* 1, 1871. By FREDERICK A. P. BARNARD, S. T. D., LL.D., President of Columbia College, New York City. Revised Edition. Printed by order of the Board of Trustees of Columbia College. New York. 1872.

This volume of nearly 200 pages has been handsomely printed and bound, and is to be largely circulated, by the trustees of Columbia College, for the purpose, as we are informed in the preface, of showing how far the views of the trustees and faculty of that institution are in harmony with those set forth in a report of a committee of the Convocation of the Regents of the University of New York State, rendered about a year and a half ago. Professor CHARLES DAVIES, who now holds a nominal connection with the College, in which he was formerly Professor of the higher mathematics, was a member of the Convocation committee, and that committee reported adversely to the introduction of the metrical system. This address is put forward, therefore, as an official disavowal of Professor DAVIES' opinions, on the part of the trustees and faculty of his college. All this has a strangely personal tone. These gentlemen put themselves upon record eight years ago as in favor of international uniformity in weights and measures. What moved them then was the importance of the subject. The same consideration should be quite enough to justify them in speaking again; and certainly it is all the motive that President BARNARD needs; for he was not connected with the college at the time of the earlier utterance (a formal memorial to Congress), and is not personally affected by the fact that Professor DAVIES has since recanted. We notice, moreover, that he does not by any means endorse the hasty views expressed by the faculty and trustees in 1864, with regard to unification of coinage; and hence, if this address is to be taken as the official utterance of these bodies, it substantially declares that they have receded from that untenable position. We are glad of this; the two questions ought never to have been mixed, and the mixing of them deprived the memorial alluded to of its influence as a plea for the metric system. For, as Dr. BARNARD says (p. 61), "while the money question has invariably elicited a large variety of opinion, and while an agreement of all the delegates [to international conferences] upon any one proposition for the unification of the coinage of the world has been found extremely difficult, if not impossible, to secure, yet, as to the question of weights and measures, there has been no difficulty whatever."

We believe we are correct in ascribing the unfortunate action of the Columbia faculty and trustees on this subject to the influence of Mr. RUGGLES, who, having committed himself and, so far as he could, the United States, to an ill-advised scheme of international coinage, tried to commit all the educational and scientific bodies he could reach to the same blunder. His enthusiastic activity in this direction failed of its object, but it had the effect of hindering the greater reform of weights and measures.

President BARNARD, in the address now before us, has wisely separated these two questions, maintaining a strong advocacy of the metric system on one hand, and a non-committal attitude with reference to unification of moneys on the other. His argument on the former question is masterly statement, clear, and logical, enlivened with humor and trenchant satire, and accurate both as to the earlier history and the most recent developments of the prolonged agitation of this subject. What he pleads for is not the forcing of a new system upon the people, against their wills, but the adoption of such means as will secure its introduction to popular acquaintance, after which its own merits will suffice to effect its general adoption.

The manner in which Dr. BARNARD deals with the current objections to the metric system, is remarkably acute and forcible; and to us (who are, it is true, on the same side of the question) it seems well nigh conclusive. The fact is, it may no longer be disputed whether we should use the metric system. We must and do use it continually; we cannot avoid teaching it to our children. It is habitually used by the vast majority of civilized nations, and is incorporated into ten or twelve distinct literatures.

In the department of postage and coinage, its use would involve no violent changes, and would lead to great reforms. For the coinage question solves itself, when coins have metric weights and uniform fineness, honestly maintained by the mint. It is only

necessary to make them, by treaty, current according to their weight, and a large part of the difficulties surrounding the question vanish at once. Doubtless this step might lead in the end to an international nomenclature, reckoning money by grammes of standard gold—the only serious obstacle to which is the existence in some countries (nominally even in the United States) of a double standard, and the adoption in some other countries of silver as the standard The recent action of Japan in this matter, establishing a single (gold) standard, is highly encouraging; while the course of the German empire, as Dr. BARNARD justly remarks, in the establishment of a new and internationally incommensurable coinage, has rendered the hope of an early and general unification "little, better than desperate." Nevertheless, the metric weight, uniform fineness, and gold standard value offer still the most practical scheme of unification.

Systematic Preparation of Mineralized Ores by Dry Crushing and Concentration.

IV.

CRUSHING ROLLS.

THE device popularly known as the Cornish Crushing Rolls has never been surpassed in the following essential features:—compactness, simplicity of construction, durability of the fixed parts, facility of repair of the parts subject to wear, economy of work per ton, and the low ratio of first cost rated by the ton of capacity. When first introduced, the single stamp head, or rude combinations of several heads in battery form, were the only competing devices for crushing; these being intermittent in execution, seemed to offer but a feeble opposition to a preference for continuous action of rapidly revolving surfaces, so arranged as to impinge upon the feed uninterruptedly. But in practice the stamp-mill proved the possession of one feature sufficiently important to give that mode of crushing superiority over the Rolls: viz. the automatic or natural adjustment of the wearing parts, so that production continued the same in quality and quantity from first to last, until the wasted parts had to be replaced. The stamps were, therefore, successfully improved and brought to a high state of efficiency, whilst the Cornish Rolls have remained almost as they were originally constructed. The former have been pressed into almost universal service and frequently compelled to do a duty for which they are not adapted, and oftentimes wholly inconsistent with the purposes to which the crushed material was subsequently destined, whilst the latter has been indifferently assigned to special work, as if there was a radical defect, irremedial, and, therefore, destructive to all the other features, which, had they not been thus impaired, would have given to the Cornish Rolls a precedence over every other device for crushing ores requiring a second manipulation for metallurgical purposes.

The positive elements of superiority possessed by the Cornish Rolls, have hitherto been strangely undervalued until recently, when Mr. KNOM undertook to complete a systematic preparation of ores which should embrace the best devices, each especially adapted to the particular duty devolved upon it, and all adapted to work in a combination, comprehending every feature essential to unvarying results in quality and certainty in quantity, at a minimum of cost in plant, as well as a minimum of cost in production The stamp-mill was not suited for this combination. Two objections, both insurmountable, prevent its adaptation, viz: excessive cost in dry work and excessive product of fine stuff, unsuited to the work of concentration, whereas the rolls produced only dry work, and that cheaply, while making also a minimum percentage of fine stuff. Had the defect, already referred to, been irremedial, such a system might have been impracticable. A study of the rolls proved that all attempts heretofore made to overcome the difficulty were neither in the right direction, nor sufficiently complete to reach the end desired. Briefly described, this difficulty resided first, in the speedy wear of the impinging surfaces of the rolls, productive of uneven work, increasing in quantity as the wear went on. Secondly, in employing a material for the face of the rolls subject to great inequality of wear, and when worn into ridges incapable of readjustment. Gearing had been adopted for meeting the wear of *even* surfaces, which wholly failed to meet the wants when the wear was *uneven* forming many cavities, grooves and ridges on the surface of the rolls.

Chilled faces had been employed to lessen this wear, but with indifferent success, inasmuch as the chilling was superficial and subject to great inequality in hardness. For the same purpose Franklinite iron was substituted with greater advantage, but still unsatisfactory. In neither case could there be provided any means of *truing* up the worn surface on account of the hardness of the material. Wrought iron was substituted with greater advantage in regard to evenness of wear, but involving too frequent changes of new for old. During this while little or no improvement was suggested in the detail of construction. Rigidity had to be compensated for by the adoption of levers, springs, weights and rubber, originating another defect while overcoming an existing evil. No means were taken to prevent waste of oil, reduce attendance, supply feed regularly, in fine, to produce a machine which embodied these essential requisites:

1st. Positive adjustability to the wear, therefore continuous equality in results.

2d. Rigidity in centers of revolution with a means of positive safety in cases of accidental emergencies, therefore non-liability to a separation of the impinging surfaces when not required.

3rd. Regularity in feed, thereby preserving evenness of comminution and lessening the return of insufficiently crushed matter.

4th. Provision for saving oil waste, thereby preserving the machine from filth as well as a needless expense.

5th. Facility for replacement of parts worn to the minimum of waste, thereby saving time, labor and cost of repairs.

6th. Combining strength of parts with the minimum of weight, thereby lessening the first cost and the cost of transportation, while giving to the machine a compactness and a finish which, in connection with the other improvements mentioned, must entitle it to be considered first class in every essential feature.

The methods by which these improvements have been reached are the following:

(*a*). The substitution of steel discs, rings or faces for the wearing surfaces, sufficiently hard to resist excessive wear, yet soft enough to allow re-adjustment by being trued up, in place, by means provided for that purpose. Both chilled and Franklinite iron are condemned for the reasons named, and steel substituted for wrought iron, because of its finer texture, greater resistence, evenness of wear and the existence of present facilities procuring steel for this purpose at no excessive advance in cost. The final waste of steel when worn is reduced to a minimum quantity, ½ inch in depth on the circumference of the roll, and this in a condition to bring almost the first cost of the raw material.

(*b*). The substitution of "breaking cups" to replace cumbrous levers, irregularly acting springs and rubber safety devices. These cups are so placed that any accidental obstruction between the impinging surfaces can be passed through at the expense of the cups, easily duplicated, whilst the rigidity of the centers of revolution is maintained during the regular operation of the machine.

(*c*). The providing a regular feeding device to prevent over-crowding, and hence a separation of the impinging surfaces, thereby allowing uncrushed ore to pass unnecessarily, incurring loss in time and power in re-working what should have been finished on its first passage.

(*d*). Providing oil cups for feeding the oil, an "oil drips" for securing the overplus, thereby preventing a useless waste, while protecting the parts exposed from the accumulation of a deposit of matter objectionable in many respects.

(*e*). Providing a new method of securing the discs or rings of steel which, while affording positive security against misplacement, allows of easy adjustment in putting on new or in taking off worn-out rings.

(*f*). Remodelling the heavy parts of the machine, providing rigid steel journals instead of flexible wrought iron, doing away with many cumbrous contrivances and inconvenient devices which have heretofore escaped the notice of mechanics engaged in following the beaten track when producing this machine.

The crushing rolls, as now furnished by Mr. KROM, are manufactured with the utmost care, every part made to a standard gauge in order that any portion can be duplicated and interchanged. The general result is a machine combining the requisites first mentioned as distinctively belonging to the Cornish crushing rolls, but the realization of which has been hitherto so inadequately obtained. As now placed before the mining public, they possess compactness, simplicity of construction, durability of the fixed parts, facility of repair of parts subject to wear, economy of work per ton, and a low ratio of first cost rated by the ton of capacity.

G. W. BAKER.

Meeting of Lehigh Furnace Managers.

Although the following report has already been printed and circulated to some extent, still we deem it of sufficient interest to receive a place in our columns.

"THE Furnace Managers of the Lehigh Valley visited Reading on Wednesday, January 24, 1872, to examine the Hot Blast Ovens of the Keystone Furnace, (Bushong's) to ascertain in what respect they differ in point of construction from those in use in this valley, and to examine particularly with reference to their being an infringement of "The Player Hot Blast Patent."

The party consisted of the following gentlemen:

"DAVID THOMAS, of the Thomas Iron Company,
WILLIAM FIRMSTONE, of the Glendon Iron Company,
SAMUEL LEWIS, of the Allentown Iron Company,
B. S. LEVAN, of the Lehigh Valley Iron Company,
DENNIS BOWMAN, of the Carbon Iron Company,
JOSHUA HUNT, of the Lehigh Crane Iron Company
SAMUEL THOMAS, of the Thomas Iron Company,
G. W. WHITTAKER, of the Saucon Iron Company,
J. C. KENT, of the Andover Iron Company,
C. H. NIMSON, of the Allentown Rolling Mill Company,
WM. H. AINEY, of the Lehigh Iron Company.

"After a careful examination of the Hot Blast in question, the party returned to the parlor of the Mansion House where a meeting was organized, by calling DAVID THOMAS, Esq., to the chair and appointing WM. H. AINEY, Secretary.

"The object of the visit of the Furnace Managers of the Lehigh Valley to Reading was stated to have been, by request, for the purpose of examining the Hot Blast Ovens in use at the furnace of Messrs. BUSHONG & Co., against whom a suit had been commenced for infringement of the patent right known as the "Player Hot Blast Patent."

"The Chairman said he would be pleased to hear from any or all the gentlemen present regarding the same.

"Mr. KENT presented and read the following letter from Mr. A. FABER du FAUR.

NEW YORK, January 22d, 1872.

"JOHN M. HARTMAN, ESQ., PHILADELPHIA—DEAR SIR: The combustion of blast furnace gases on a fire bridge can be dated back to at least 1837. Such a fire bridge forms a chamber where the gases are ignited and consumed by atmospheric air before reaching the article to be heated. The annexed sketch

shows a hot blast which I built before 1850, in Germany, and which Mr. ELW. COOPER has seen there, but I don't know that it has been published. I have no doubt that a search in foreign publications prior to 1864 will show a number of hot blasts with separate fire-bridges or combustion chambers. The Westham Furnace, near Richmond, Va., which was built before the war, had a lower chamber with openings leading to the pipes above.

"The combustion of furnace gases by atmospheric air in a chamber, of any shape, previous to reaching the article to be heated, having been well known previous to Player's invention, his claim becomes void; the advantage in his apparatus is simply the use of a much larger amount of pipe surface than had been previously used.

"If you refer to the specification and drawings of my father's application at the U. S. Patent Office made some time after 1840 by C. E. DETMOLD, you will find gas-furnaces where the gases are burned by hot air, the flame being used for refining or puddling and the waste flame (gases previously consumed,) heating air for combustion.

"You will have to bear in mind that in a lawsuit anything done in a foreign country will only be good evidence if fully described in a printed publication previous to the date of the alleged invention.

Yours truly, A. FABER DU FAUR."

He then stated the progress which had been made in the construction of Hot Blast Ovens, commencing with Blaina's, which was built in 1837, a drawing of which he presented in a printed volume published in 1864, and entitled "Percy's Metallurgy," showing that as early as 1837 the plan of igniting the gases in a combustion chamber separate and apart from the pipe chamber had been put in practical use.

The Chairman (Mr. THOMAS) stated that he had built in 1846, in Catasauqua, a hot blast with a combustion chamber on the same general plan.

Mr. LEVAN stated that he had built one at the Lehigh Valley Iron Works at Coplay in 1854.

Mr. FIRMSTONE stated that he had had hot blast ovens in use at the Glendon Iron Works, containing the combustion chamber separate from the pipe chamber, for from fifteen to twenty years past. He could not see how the patent claimed by the assignees of Mr. PLAYER could be maintained, for what is claimed in that patent, *i. e.* the igniting and consuming of the gases in a combustion chamber communicating with the pipe chamber by narrow openings only, has been in use in various forms in the Lehigh Valley for over twenty years, as he understood it.

Mr. SAMUEL THOMAS stated that he placed in the Patent office in Washington in 1858, a model which would be found to contain substantially the same combustion chamber with the narrow openings communicating with the pipe chamber, and that he had superintended the building of a Hot Blast similar to that model at Boonton, N. J., about that date.

Mr. WHITTAKER stated that he had superintended the building of a similar Hot Blast Oven at the Durham Iron Works, near Riegelsville, about fifteen years ago, and that they were by no means considered new or novel at that date.

After further remarks by the Chairman and others Mr. AINEY offered the following, which was unanimously adopted:

Resolved, That a careful examination of the Hot Blast Ovens in use at the furnace of Messrs. BUSHONG & Co., against whom, as we are informed, a suit has been commenced by the assignees of the Player Hot Blast Patent, for infringement, has satisfied us that there is no tenable ground upon which (under the specifications and claims filed,) to base and maintain an action for infringement, believing the patent to be void, in as much as the invention claimed was known and in use prior to the date of that patent.

Resolved, That we will bring this subject matter to the notice of our respective companies with a view to our own protection, and to consider whether we are not liable to be similarly annoyed, and what action may be proper and advisable under the circumstances.

Copper Mining Here and Elsewhere.

THE price of copper has advanced to 28 cents per pound, and the consumption of this metal has been increased in an extraordinary degree within the last 18 months, while from various causes, but principally on account of the low price previously ruling, the product of the world has been steadily diminishing. Thus the product of the mines of Chili, which in 1868 was 56,500 tons, has dwindled down to 42,400 tons in 1871, and the United Kingdom of Great Britain, from a product of 11,153 tons in 1866, fell off to 6,500 tons in 1871. The Lake Superior mines produced in 1871 about 12,000 tons, a large proportion of this coming from three or four of the successful mines, which were enabled to work at a fair profit even at prices for copper which stopped mining operations generally. The stock of copper on hand Jan. 1, 1872, in England was 11,300 tons of ingot, against 24,000 tons at the same date in 1871, and 16,900 tons in 1870. At Havre, the stock on hand, January, 1872, was 4,590 tons, against 8,670 tons in 1871. The recent extraordinary demand in Europe is to a large extent the result of substituting the breech-loading for the muzzle-loading musket in the standing armies of the great Powers, thus compelling the use of the metallic cartridge, the shell of which is composed of copper. To provide armies of from 200,000 to 500,000 men with these metallic cartridges for practice, and to keep stores in reserve in the arsenals against the contingency of war, has necessitated the purchase of copper to an extent which appears almost incredible, *The London Mining Journal* estimating the consumption in the manufacture of cartridges alone at 15,000,000 pounds, or 7,500 tons, in 1871; while the constant loss of the metal in the waste of the exploded shells of the cartridge is enormous. In the use of revolvers and breech-loading fowling-pieces also, which are rapidly supplanting the muzzle-loading arms, the metallic cartridge is a necessity, and from the manufactories of this destructive little article a demand for copper has sprung up which probably exceeds its consumption in any other way two-fold. Hence the rise in the metal and a stimulus to copper mining which is now beginning to manifest itself in the Lake Superior district of this country.

It will not be uninteresting at this point to note the changes in copper mining in this part of the country, which embraces the only copper-bearing territory now worked here. The discovery of native copper on Lake Superior astonished and confounded geologists, and its development in masses of almost pure metal varying from 50 to 500 tons, was considered a scientific wonder. The mines producing these rich marvels were worked for a number of years with great success, and such mines as the Pittsburgh (cliff) and Minnesota were brilliant affairs for the time, yielding large dividends and great profits upon the original investments. The consequence was a rapid and unhealthy growth of mines throughout the copper-bearing strata extending from Keweenaw Point through Portage and the Ontonagon districts, based mainly upon the splendid results of the Pittsburgh and Minnesota. Some of these were for a time very successful; but at length the great masses began to diminish, the barrel-work proved uncertain, and one after another mines were stopped or feebly worked, and at length entirely abandoned. Some of these mines had introduced stamps to separate the small particles of copper from the rock taken out to secure masses and barrel work; but as this process yielded but from 1 to 2 per cent. of metal in the ton of rock, or from 20 to 40 pounds of metal to the ton crushed, it was considered only as an accessory to other mining, and not self-supporting. Hence, when masses became scarce, work was suspended in a majority of cases. A few mines, however, continued to work, and in these instances attention was turned to the economies of mining, which before had been only of secondary consideration. New and improved machinery was introduced; more powerful stamps to crush the rock, and steam-drills to take it from the veins, replaced the old machinery, while at the same time many of the old and erroneous principles of mining were abandoned, giving place to intelligent and systematic processes. By degrees this persistence had its reward, and even at low prices for copper —say 19 to 20 cents per pound—very good profits were realized upon neglected and comparatively despised copper-bearing rock yielding but from 20 to 40 pounds of metal to the ton. Under this new phase in copper mining, the great Calumet and Hecla mines have made their large profits and dividends; and at the present time nearly every mine on Lake Superior which is honestly worked is mainly dependent upon its stamp stuff—so little valued twenty years since. This is a substantial revolution in copper mining in this country, and is destined to produce a change of opinion in regard to its profits and in regard to the value of the copper bearing veins of the Lake Superior district. Upon the Calumet and Hecla veins copper can be produced, mainly from stamp stuff, at a cost of about 12 cents per pound, a clear profit, at present market prices, of 16 cents per pound. The Quincy, on Portage Lake, under the same system, paid a profit of $195,000 the past year, while the Copper Falls, which at one time, after giving out in masses and barrel work, was considered almost worthless, is earning now a clear profit of 10 cents per pound upon its product, and has been making regular dividends of $1 per share semi-annually. These facts have of late turned attention to copper mining, and in Boston, where most of the Lake Superior Companies are managed, there is developing an interest which promises to stimulate a speculation in copper stocks beyond any experience in that headquarters of copper mining. In time, Lake Superior will lead the copper product of the world.—*N. Y. Tribune.*

Electromagnetism.

THE following remarks on electromagnetism, which has been the subject of so much discussion in England and in this country, were made some time ago before the Polytechnic Association, and will, we think, be read with interest, though the general discussion of the matter has been pretty much dropped of late.

Prof. JOHN PHIN—At the meeting of the British Association last September, a paper was read by Rev. H. HIGHTON, which has attracted a great deal of attention both in Europe and in this country, particularly among persons fond of reading about scientific pursuits, and who imagine that the field of discovery is almost unlimited, but the foundation of whose knowledge has not been laid broad and deep. The paper of Mr. HIGHTON was to the effect that the old ideas of the correlation of forces are entirely erroneous, and therefore are not to be taken into account in any calculations upon the application of heat, electricity, or any other force, for motive power. We shall get his views more clearly by reading the opening passage of his paper contributed to the January number of the *Quarterly Journal of Science*. He says:

"I think that I may say, first, that the theory at present accepted, and which it would be considered somewhat heretical to deny, is this, that a certain amount of chemical change corresponds and is interchangeable with a certain amount of heat and electric force; and that this heat again corresponds and is interchangeable with a certain amount of work or mechanical energy. This is no doubt a very pretty, plausible, and apparently philosophical theory; but is it true? or how far is it true? This is the question I now propose to consider, with a special view to the further question of the economy of electro-dynamic engines."

If there is any one feature peculiar to modern science, it is that it is cumulative. Plato, Pythagoras, or Socrates were men as capable as any of the present day; but our knowledge vastly exceeds theirs, because standing upon their shoulders we can see further than they did. It becomes important, there-

fore, if a single stone in the foundation of our great system of science is suspected of being unsound, that we should determine whether it is so or not. And I propose to-night to show you the errors which Mr. HIGHTON has made, and that we have therefore no reason to abandon the laws from which we have come to the conclusion that in the present state of our knowledge elcectromagnetic engines are not and cannot be made economical.

The experiment of Mr. HIGHTON is this. With a certain battery, connected with a certain electromagnet he supports a certain weight. He then connects the same battery with four similar magnets, the wire dividing and each section passing around two magnets, and it supports double the weight. He concludes that that series can be multiplied to any extent, and thus that the power can be increased *ad infinitum*. Lest I should be thought to be caricaturing his argument, I will quote his exact words, from the *Chemical News* of October 28. He says:

"In trying experiments on this subject, the author found that the magnetic power evolved by a given battery could be increased without limit. This was the case both in theory and practice. * * * By simply increasing the length and section of the wire, the magnetic power may be increased without limit. * * * Enough has been said to set aside the *à priori* argument against electro-dynamic engines—namely, that as a pound of zinc can only produce a certain amount of heat, and a pound of carbon, which is much cheaper, can produce more heat, therefore electro-dynamic engines can never compete with steam engines. In fact, it is a question of prime cost of machinery and skill in construction, and not of cost of working."

Now if you examine the conditions of Mr. HIGHTON's experiments, you will see the cause of the apparent increase of power. An ox can drag four wheelbarrows as well as one. Hitch four baby-carts to a horse, and you will not see any signs of weakness. Mr. HIGHTON used a very strong battery; and hence, when you put on the additional electromagnets, with twice the length and twice the thickness of wire, he produced apparently a greater force. Yet he does not get the same force from each additional magnet. There is a limit to it.

The question arises, what are the conditions under which the greatest power will be evolved by any galvanic circuit? If a waterwheel turns with the velocity of the stream, it gives no power; if it stands still it does no work. The law is that it does the greatest work when it moves with one-half the velocity of the water. So the galvanic battery does the most work when the work outside is equal to the work inside, *i. e.*, the resistance of the wire must be equal to one-half the maximum power of the battery; or the resistance in the coil should be equal to the resistance in the liquid.

Of the success of the electromagnetic engine I have no doubt; but when we consider its economy as compared with steam, we must remember that in the steam engine we have carbon, a substance having a very low chemical equivalent, whereas in the voltaic engine we burn zinc, a substance having a high chemical equivalent. It takes more than 32 lbs. of zinc to do the work of 6 lbs. of carbon. Moreover, the 6 lbs. of carbon are raised to such a height that they fall twice as far—*i. e.*, each equivalent of carbon combines with two equivalents of oxygen, whereas zinc combines with but one; so that the proportion is as 11 to 1 in favor of carbon. But, taking the market value into consideration, the difference is vastly greater, for zinc costs $320 a ton.

The following remarks were then made:

The PRESIDENT—The cost of the power is about 25 times that of steam power.

Dr. VAN DER WEYDE—For oxidizing zinc we are obliged to use an acid which costs money. For oxidizing coal we use air, which costs nothing.

Mr. FISHER—The cost of the zinc will not amount to anything, for we can sell the zinc paint for more than the zinc costs.

Dr. VAN DER WEYDE—Experiments which I tried thoroughly many years ago, the apparatus for which is still in this building, fortified the position taken to-night by Prof. PHIN. I commenced in Holland, in 1838 or 1839, to make an electromagnetic engine to turn my lathe with. It did the work successfully, but it consumed a tremendous amount of zinc. About two years ago, a gentleman by the name of PREVOST asserted that the power of a battery could be increased by adding magnets. The fact is, that so long as the resistance in the coil is less than the resistance in the battery, you can increase the power until you make them equal. But many who make such machines do not know how to calculate the resistance. In the first place, it is in inverse ratio to the section of the wire. Then there is another principle. If you have two wires, and if the resistance in one is 100 times that in the other, the current will not all go in the easiest way, but one hundredth part of it will go the other way; or rather, 100 times as much will go the easiest way as goes the other way.

Mr. STETSON—What will be the effect if the magnet does work.

Dr. VAN DER WEYDE—It will affect it by interrupting the current. The magnetization and demagnetization of the iron will interfere with the primary current and diminish it. In other words, it will increase the resistance.

Dr. BRADLEY—What will be the effect of the armature?

Dr. VAN DER WEYDE—When loaded with an armature the resistance will not be changed; but when they are not loaded, so that the magnetism is free to manifest itself, the resistance will be increased. Taking off the armature will increase the resistance.

The PRESIDENT—The gain in multiplying these magnets is like the gain by a lever. It is a gain in the manner of using the power.

Utah Ores.

BY PROF. B. SILLIMAN.

The ores of the mines thus far opened in the Wahsatch Mountains are largely composed of species resulting from the oxidation of sulphides, especially galenite and antimonial galena, with some salts of zinc and copper, all containing silver and rarely a little gold. Iron and manganese ochers occur in considerable quantity in some of them; but the process of oxidation has prevailed very extensively, so that the ochraceous character of the ores is the striking feature of most of the mines in this range.

The great chamber of the Emma Mine, which is an ovoidal cavity measuring, so far as explored, about 110 feet vertical by about 80 by 110 feet transverse, was found to be filled almost exclusively with epigene species, the product of oxidation of sulphides, and capable of removal without the aid of gunpowder for the most part. The study of this mass reveals the interesting fact that it is very largely composed of metallic oxides, with but comparatively small proportions of carbonates and sulphates. Fortunately I am able to present an analysis of an average sample of 82 tons (=183,080 pounds) of first class ore from the Emma Mine, made by James P. Merry of Swansea, April, 1871, which is as follows, viz.

Silica,	40.90	Silver,	0.48
Lead,	34.14	Alumina,	0.35
Sulphur,	2.37	Magnesia,	0.25
Antimony,	2.27	Lime,	0.72
Copper,	0.83	Carbonic acid,	1.50
Zinc,	2.92		90.42
Manganese,	0.15		
Iron,	3.54	Oxygen and water by diff'e.,	9.58
			100.00

The quantity of silver obtained from this lot of ore was 156 troy ounces to the gross ton of 2240 pounds.

This analysis sheds important light on the chemical history of this remarkable metallic deposit, and will aid us in the study of the paragenesis of the derived species. It is pretty certain that all the heavy metals have existed originally as sulphides, and we may, therefore, state the analysis thus, allowing 8.52 sulphur to convert the heavy metals to this state.

Silica,	40.90
Metalic sulphides,	52.60
Al ·35, Mg ·25, Ca ·72, $\dot{M}n^2$, $\ddot{M}n$ ·20,	1.52
	95.02
Water, carbonic acid and loss,	4.95

This calculation assumes that the sulphides are as follows, viz:

Galenite,	38.69
Stibnite,	3.30
Bornite,	1.03
Sphalerite (blende),	3.62
Pyrite,	5.42
Argentite,	0.54=52.60

This statement excludes the presence of any other gangue than silica, and I considering that the ores exist in limestone, the almost total absence of lime in the composition of the average mass is certainly remarkable. The amount of silica found is noticeable, since quartz is not seen as such in this great ore chamber, nor so far as I could find, in other parts of the mine. The silica can have existed in chemical combination only in the most inconsiderable quantity, since the bases with which it could have combined are present to the extent of less than 1½ per cent, nor do we find in the mine any noticeable quantity of kaolin or lithomarge, resulting from the decomposition of silicates, nor are there any feldspathic minerals. It is most probable that the silica existed in a state of minute subdivision diffused in the sulphides as I have seen it in some of the unchanged silver ores of Lion Hill in the Oquirrh range.

The absence of chlorine and of phosphoric acid in the analysis corresponds well with absence of the species *cerargyrite* and *pyromorphite*, of which no trace could be found by the most careful search among the contents of the mine. The miners speak of the "chlorides," and the unscientific observers have repeated the statement that silver chloride is found in the Emma Mine, but the ores indicated to me as such are chiefly antimonic ochers.*

The general (perhaps total) absence of the phosphates of lead in the Wahsatch and Oquirrh Mountains, so far as explored, is a striking peculiarity of the mineralogy of these ranges. On the other hand, the absence of chlorine in the mines of the two Cottonwoods and the American Fork is in striking contrast with the constant occurrence of cerargyrite (horn silver) in the Oquirrh and also in the southern extension of the Wahsatch. I have sought in vain for a trace of this species in the districts of the Wahsatch just named, and the occurence of pyromorphite is extremely doubtful.

Molybdic acid, however, exists pretty uniformly disseminated in the mines of the Wahsatch; in the form of *wulfenite*. Although it occurs in minute quantity, it is rarely absent, and may be regarded as a mineralogical characteristic of the districts of the two Cottonwoods and of the American Fork. For this reason a few particulars will be in place here.

Wulfenite is found associated with calamine (*smithsonite*), cerusite, malachite, azurite and more rarely alone in little cavities in the ochraceous ores. In the "Emma Mine," vugs, or geodes, are occasionally found lined with botryoidal, apple-green calamine, rarely crystallized, often brownish and sometimes colorless, but invariably associated with wulfenite. The calamine encloses and covers the crystals of wulfenite, which form a lining of considerable thickness. The wulfenite is in thin tabular crystals of a yellow color, resembling the Carinthian variety of this species. The crystals are very brilliant and perfect, but quite minute, rarely two or three millimeters in width, and not over 1mm. in thickness, often less. They are quite abundant in this association, no piece of the calamine which I have seen being without them. They sometimes, but rarely, penetrate through the globules of the calamine so as to show themselves on the upper surface of that species. But the calamine has obviously formed botryoidal masses around the wulfenite, a crystal of this species being often seen forming the nucleus of the calamine gobules.

These facts are of interest in the paragenesis of these epigene species. The order of production has obviously been, first, the cerusite resting on ochraceous iron, manganese, and other metallic oxides; next, the wulfenite crystals were deposited upon and among the crystals of cerusite, and lastly came the calamine, crystalline at first, and as it accumulated becoming fibrous and amorphous, completely enclosing and capping the other species.

*There exists generally among the mining population of the central territories of the United States a distinction between *horn silver* and *chloride of silver*, an error arising, as I am persuaded, from supposing the ochraceous ores to be chlorides not so perfectly developed as to be sectile.

Wulfenite occurs also in this mine, as likewise in the "Flagstaff," the "Savage," and "Robert Emmet," without the calamine, but never, as far as observed, without cerusite and other carbonates. In the "Savage," masses of cerusite with various oxides are interpenetrated by the tabular crystals of wulfenite.

Although wulfenite forms a very minute factor of the entire ore mass in these mines, by the law of mineral association it may be considered as the characteristic species of the ores of these districts, occuring in the magnesian limestones. So far as I am informed, or have observed, wulfenite has not been hitherto found in any of the other mining districts of Utah; but by the same law, it may be reasonably looked for whenever deposits of epigene minerals are explored in the same geological and mineralogical relations in the Wahsatch range of mountains.

The oxidizing and desulphurizing agency which has acted upon the great ore mass of the Emma Mine, whatever it was, has performed its work with remarkable thoroughness. A careful study of its action discloses some other facts of interest in the paragenesis of species. From the appearance of numerous large blocks of ore forming solid boulders in the general mass, a concentric arrangement is easily recognized. On breaking these masses across, the fresh fractures disclose a dark center which consists almost entirely of decomposed sulphides, composed chiefly of cerusite blackened by argentite and metallic silver in a pulverulent form. This dark center, chiefly of cerusite, is often pseudomorph of galenite in its fracture. Next is usually a zone of yellowish and orange yellow antimonial ochre, cervantite, often quite pulverulent, at times only staining the cerusite; then follows a narrow zone of green and blue copper salts, malachite, azurite, cupreous anglesite, with, rarely, wulfenite; then follows cerusite, sometimes stained with antimony ochre, and not unfrequently associated with wulfenite; outside all are the iron and manganese ochres. This concentric arrangement I have observed in a great number of cases; and the above order of species, while not invariable, is believed to reflect accurately the general arrangement. Well crystallized species, as mineralogical specimens, are rare in this great mass, but the following may be recognized as its chief components.

Galenite, sphalerite, pyrite, jamesonite (?), argentite, stephanite, boulangerite (?), *antimonial galenite*, *cervantite*, mimetite (?), limonite, wad, kaolin, lithomarge, *cerusite*, anglesite, linarite, *wulfenite*, *azurite*, *malachite*, *smithsonite*. Those most abundant or best crystallized are in italics. This list can no doubt be extended as opportunity occurs for the more careful study of the ores, the great mass of which, amounting to many thousand tons, have gone into commerce without passing under any mineralogical eye.

In a subsequent paper will be presented some remarks upon the Oquirrh range and some of its ores, and notices of minerals from other districts of Utah.

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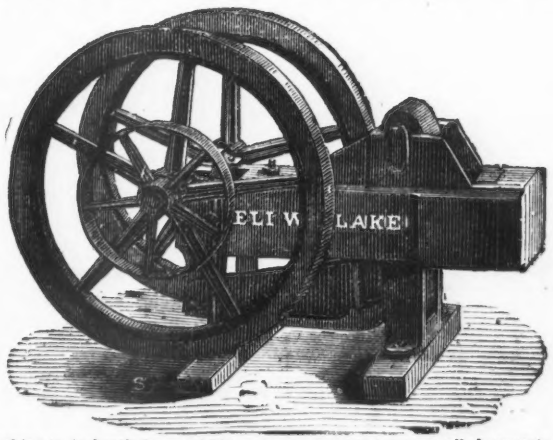

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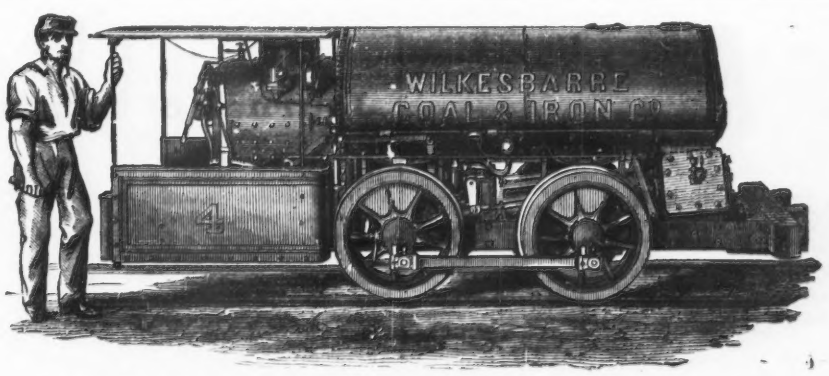

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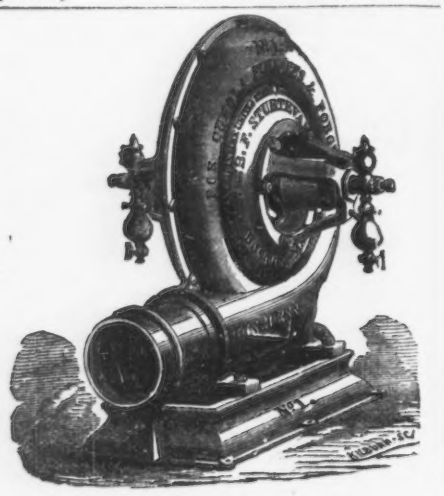

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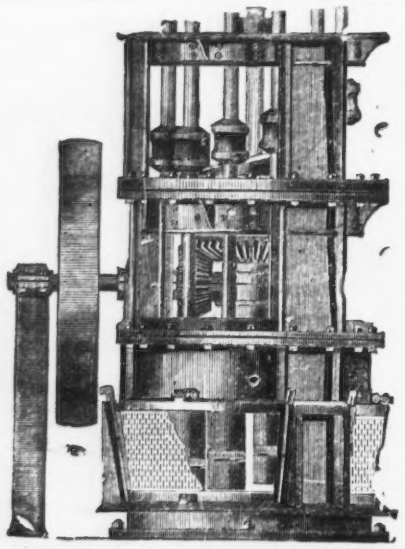

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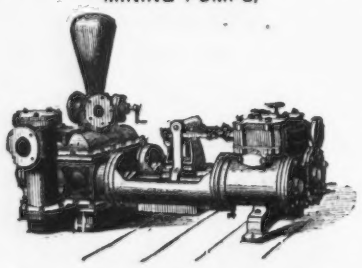

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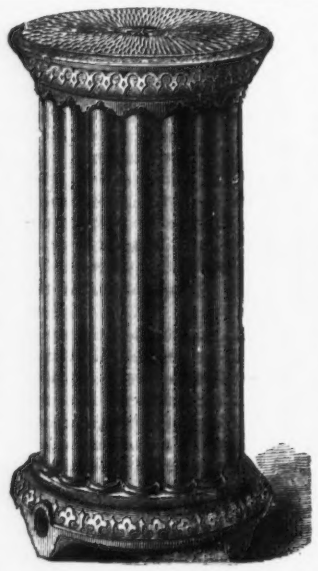

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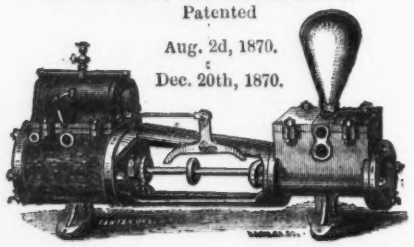

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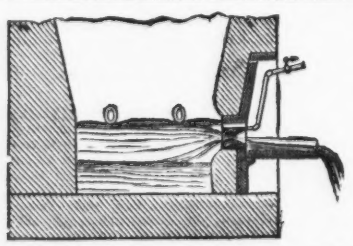

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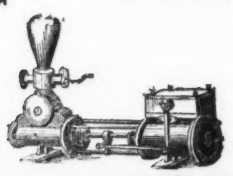

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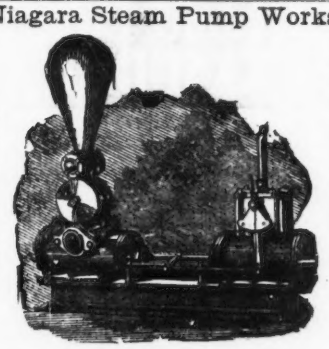

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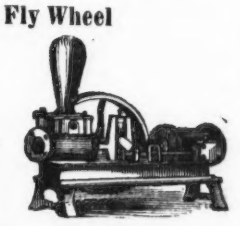

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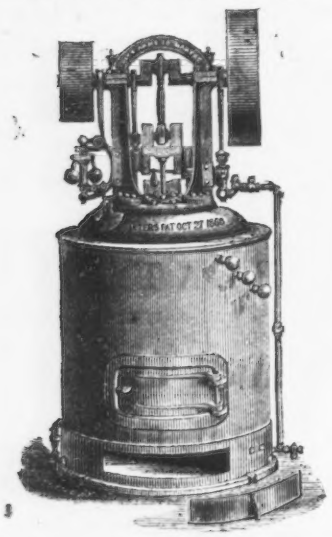

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